Engineering and Mining Journal

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New Philippine Government Inherits a Mining Industry

SEPTEMBER 17 was historic in the annals of the Philippine Islands. On that day the qualified voters elected a president and legislators who will take office on November 15 and inaugurate the ten-year probationary period of self-government that will end with political independence. It is idle to speculate on what might have changed this course of events, considering the shifting fortunes of the independence movement in the Islands and in the United States. But one wonders whether an earlier knowledge of the mineral resources of the Islands, and American participation in their development, might not have influenced the tide of public opinion on the subject. By a strange twist of fate Americans underestimated the mineral value of the Philippines, with the result that home capital is now developing a substantial gold-mining industry and uncovering promising deposits of chrome ore and other minerals. With a probable gold production of $15,000,000 in 1935, the Islands will rank ahead of Alaska and close to the leading gold producing states —California and South Dakota. Developments during the next ten years may easily enhance the value of Philippine mineral resources and make them an important asset of the new commonwealth when it is finally launched.

Further Attack On Silicosis Evil

UNIQUE in the relations between government and industry is the recently created Massachusetts Division of Industrial Hygiene. Governmental agencies usually are established to administer laws, to exercise police powers in "cracking down" on those who evade compliance. But here is a unit of state government whose sole function is to consult and advise with industry in all matters pertaining to the health of workers. Without compulsion it places at industry's disposal, on request, the best scientific advice and counsel of its expert staff. Under the direction of Manfred Bowditch, Massachusetts has taken a step that may well be followed by other states, particularly those in which the problem of silicosis confronts the mining industry.

Massachusetts is not a mining state, but its industries include quarrying, stone crushing, and granite cutting, in which inorganic dusts may cause silicosis. The new division has organized a granite dust control project, for which a typical granite shed has been obtained. Here it is proposed to study, design, and erect a number of devices that will remove and collect the dust incident to normal operations. When the work is completed the results will be published, and the granite-cutting industry will know how to control harmful dust at minimum cost.

In addition to conducting this study, Mr. Bowditch and his staff of one chemist and one engineer are available to Massachusetts industries seeking their services in dust measurement and removal. Legislation is not contemplated until sufficient scientific and technical data are obtained on which to base reasonable laws. We commend this approach to the subject to industrial commissioners in mining states.

Engineering Index Should Be Supported

ENGINEERING INDEX, as its name implies, is an annotation, world-wide in scope, of current technical literature. It is complete, authoritative, and up to date. It holds the same value for engineers of all classes that the well-known *Chemical Abstracts* has for chemists. For fifty years the Index has made available to research and production engineers of American industry an abstract of progress in engineering science. Available currently in card form or annually in a bound volume, it becomes an invaluable work of reference.

Because of the great cost of assembling and classifying its wealth of information, the Index has been in financial straits. To save and perpetuate this tool so necessary to industry, a group of far-seeing engineers, educators, and industrialists, headed by Collins P. Bliss, dean of engineering, New York University; Dr. Frank B. Jewett, president, Bell Telephone Laboratories; and Dr. John V. N. Dorr, president, The Dorr Company, are undertaking to raise a working capital fund to see the Index through a five-year period under a plan to make it self-sustaining at the end of that time. The appeal is directed to American industrial corporations which benefit directly or indirectly through the application of engineering.

In view of the fact that mining and metallurgy comprise two large divisions of the Index, companies in those fields have an interest in perpetuating the work. Contributions in any amount will be welcome and may be paid in five annual installments. *Engineering and Mining Journal* is glad to voice this appeal of the committee, which includes one member so well known throughout the mining industry.

Pensions for Workers Under

Employers and Employees Will Be Taxed to Provide Monthly Payments for Those Reaching the Age of 65 After January 1, 1942

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ONE of the most important acts of the recent Congress was to pass the President's measure designed to provide a foundation for the economic and social security of the American people. Known as the Social Security Act, it provides for (1) financial assistance to aged needy individuals, (2) old-age pensions for workers attaining age 65 on or after Jan. 1, 1942, (3) unemployment compensation, (4) financial assistance to dependent children, (5) maternal and child welfare, (6) public health work, and (7) aid to blind.

The mining industry, of course, will be taxed heavily for the administration of this all-inclusive social measure. But primary interest will center in that part of the act relating to old-age pensions. The following analysis, therefore, deals only with that aspect of the legislation and shows the obligations of mining companies and the benefits to their employees.

When does the plan start?

The levying of taxes for the pension account begins Jan. 1, 1937, but payment of pensions does not begin until Jan. 1, 1942.

Who are eligible and qualified to receive pensions?

All employees within the United States, Alaska, and Hawaii who reach age 65 on or after Jan. 1, 1942, and to whom not less than $2,000 total wages was paid beginning Jan. 1, 1937, at least one day's wage being paid in each of the calendar years 1937 to 1941 inclusive; except agricultural labor, domestic servants, employees of religious and charitable organizations, officers and crews of vessels documented under the laws of the United States, and employees of Federal, State, and municipal governments.

On what basis are pensions to be paid?

On the basis of age, annual income from employment, and length of employment up to age 65. On or after Jan. 1, 1942, each eligible and qualified worker reaching age 65 will receive a Federal pension amounting to one-half of 1 per cent of the first $3,000 of total income from employment after Jan. 1, 1937. If such income was more than $3,000 he will receive in addition one-twelfth of 1 per cent on the next $42,000, and one-twenty-fourth of 1 per cent on all such income over $45,000. There is a limitation, however, of $3,000 per year on all salaries and wages considered for pension calculations. Workers receiving more than that sum will be pensioned only with respect to that much of their income. The maximum pension receivable is $85 per month after 45 years of service.

The accompanying Table I shows the benefits based on average monthly salary and years of employment. Thus, a worker drawing $100 per month who is age 55 on Jan. 1, 1937, would receive a pension beginning Jan. 1, 1947, on attaining age 65, of $22.50 per month for the rest of his life. Other combinations can be worked out by reference to the table.

It is immaterial whether a man takes a new job every month from the time he is 20 until he is 65. He gets credit for every day's work after Jan. 1, 1937, because every employer has to make a return to the Government on each and every employee.

Table I—Federal Monthly Pensions at Retirement, Age 65, for Various Periods of Employment

Average Monthly Salary	Years of Employment								
	5	10	15	20	25	30	35	40	45
$25	*	$15.00	$16.25	$17.50	$18.75	$20.00	$21.25	$22.50	$23.75
50	$15.00	17.50	20.00	22.50	25.00	27.50	30.00	32.50	35.00
75	16.25	20.00	23.75	27.50	31.25	35.00	38.75	42.50	46.25
100	17.50	22.50	27.50	32.50	37.50	42.50	47.50	51.25	53.75
125	18.75	25.00	31.25	37.50	43.75	50.00	53.13	56.25	59.38
150	20.00	27.50	35.00	42.50	50.00	53.75	57.50	61.25	65.00
175	21.25	30.00	38.75	47.50	53.13	57.50	61.88	66.25	70.63
200	22.50	32.50	42.50	51.25	56.25	61.25	66.25	71.25	76.23
225	23.75	35.00	46.25	53.75	59.38	65.00	70.63	76.25	81.88
250	25.00	37.50	50.00	56.25	62.50	68.75	75.00	81.25	85.00

*Lump sum payment of $52.50.

the New Social Security Act

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Members of the Federal Social Security Board. Mr. Winant is Chairman

Are benefits payable at death of eligible workers?

If an eligible worker dies before reaching 65, his estate will receive an amount equal to 3½ per cent of the total wages paid to him from Jan. 1, 1937, up to the time of his death. Should he die after being pensioned at age 65, but before he has received the equivalent of 3½ per cent of his total salary, the difference will go to his estate.

Must a worker retire at age 65?

No, but there is a penalty attaching to anyone continuing to work after age 65. He must continue to pay his tax and on later retirement will get a smaller pension than would have been received at normal retirement age. There is no provision for retirement before age 65.

How is pension fund to be raised?

By taxes, of course—an income tax on employees and an excise tax on employers.

Employees will pay a tax on their income from employment, as follows:

Calendar Year	Per Cent of Wages
1937-8-9	1.0
1940-1-2	1.5
1943-4-5	2.0
1946-7-8	2.5
After Dec. 31, 1948	3.0

This tax will be collected by the employer by deducting it from the employees' wages as and when paid. This tax is *not* allowed as a deduction to the individual in computing his annual net income.

The employer likewise will pay a tax on his payroll in the same percentages and for the same periods indicated for employees.

The total tax thus levied, ultimately 6 per cent of payrolls, is to be paid into the Treasury of the United States, from which appropriations will be made to the Old-Age Reserve Account for the payment of pensions by the Social Security Board.

How many workers will be affected?

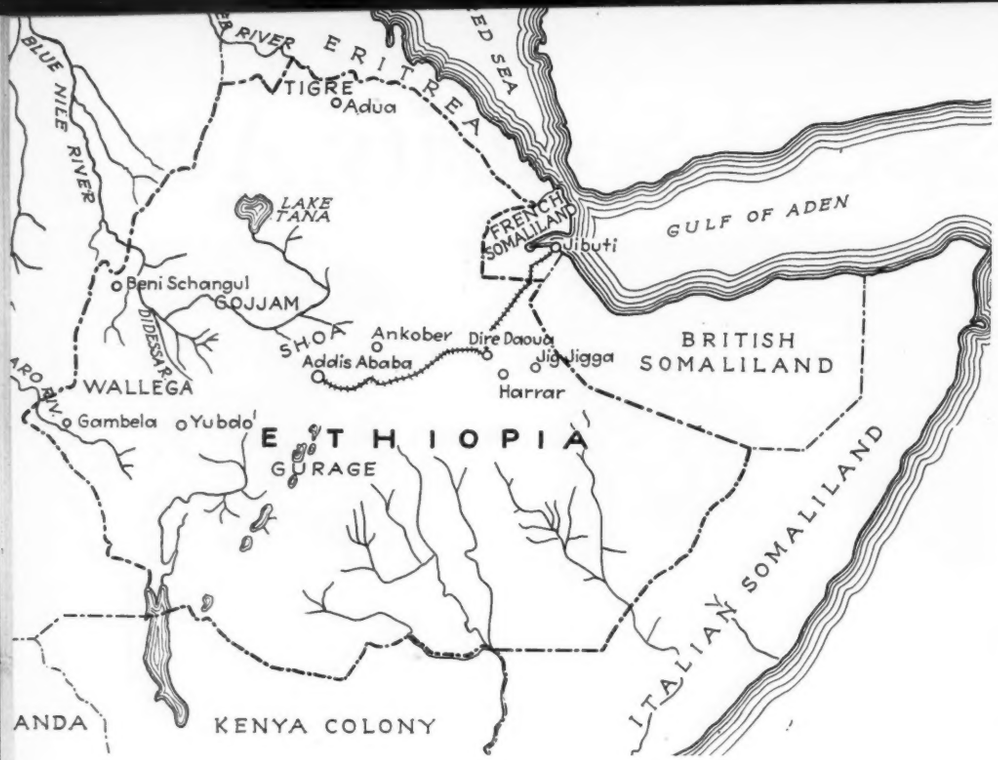
Approximately 30,000,000 all told; possibly 1,000,000 in the entire mining industry. The census of 1930 listed over 48,000,000 persons gainfully employed, but at least 16,000,000 of them in agriculture, domestic service, and other exempt classifications will not be eligible under the Social Security Act. Further, it is estimated that there are now 2,000,000 workers over 65, and another 2,000,000 who will reach age 65 before Jan. 1, 1942, when pension payments are scheduled to begin. So that there are now 4,000,000 workers who will not be eligible.

What effect will this plan have on private pension plans now in force?

None, necessarily, particularly in the case of "insured" or "trusteed" plans, but some modification will be necessary to avoid overlap. Private company plans now met as a charge against payrolls are likely to be modified by reducing the private pension by the amount of the Federal pension. Thus, the total pension to the individual receiving $3,000 or less per annum would not be reduced. But private plans usually cover all employees regardless of income, and to abandon them would work a hardship on employees not fully covered by the Federal plan. Some company plans that are neither insured nor trusteed may fall by the wayside, but they can be superseded by new plans covering all employees on a sound actuarial basis.

How do the proposed pensions compare with those under a private plan?

The Federal pensions are inadequate for real needs. Compared with benefits under an *average* insured private plan, they are higher in the lower-wage groups and for short terms of employment before age 65. But they do not apply to wages or salaries in excess of $3,000 a year, or $250 per month, and they are not as high as *average* private pensions in higher-wage groups up to $3,000 limit and for longer terms of employment before age 65.



Ethiopia's Mineral Wealth

. . . As Yet But Little Known

PROSPECTING for minerals and mining on a primitive scale have been carried on in Ethiopia since ancient times. No authentic information based on scientific investigations is available, which justifies the assumption that the country has vast valuable undeveloped mineral deposits. Some gold, silver, and platinum have been produced. Other minerals also occur.

With the aid of foreign advisors the Emperor is at present attempting to codify an Ethiopian mining law and has created a Department of Mines. Prior to 1933 practically all of the exploration work and actual production of minerals on a commercial scale were conducted by foreign individuals or corporations. However, in December, 1933, the Bonmon Mining Company was organized and financed entirely by Ethiopians, but with a staff of foreign technical advisors.

In the absence of any mining legislation or other legal means of insuring adherence to a contract, concessions negotiated by foreigners have been highly speculative ventures. If and when a concession is granted and the proper documents are signed by the Emperor, the latter is required to communicate with the provincial chief in whose territory the concession is located, "ordering" that the concessionaire be permitted to conduct the exploration work in accordance with the agreement. Until very recent times, passive, and in many instances active, resistance to such "orders" was evidenced by the provincial chiefs. This situation has long been recognized by the Emperor as the most serious obstacle in the development of Ethiopia's mineral resources by foreign capital, and the losses sustained by foreign individuals through the abrogation of contracts has led to the adoption of a new policy by him by which he negotiates directly with corporations known to have extensive financial resources and believed to have the support of the foreign Government involved.

Gold mining in Ethiopia dates back to about 2,000 B.C. In modern times, it was reported by the Portuguese in the seventeenth century as being conducted in Wallega Province, on the western border. The Wallega Gold Mining Company, of English origin, was formed in 1898. A few years later, quartz veins near Mount Nagio were investigated by an Italian engineer, who reported an average grade of 20 to 25 grams per ton. Lack of transport facilities, however, has prevented large-scale operation.

In recent years the Beni Schangul area has been the scene of greatest exploratory work and is now yielding two-thirds of the country's gold output, which totals about 700 kg. of metal annually. In 1927, some deposits were located by a German, which have since been taken over by the Ethiopian mining company. Other auriferous areas are reported as follows: The Nirouadda tributary of the Baro River, south of Beni Schangul; the Didessa, Chankalla, Doubba, and Ouallaga rivers; at Dul, near the Anglo-Sudan boundary; to the northwest in the Blue Nile Valley, at Mount Sennaar, where an English company has worked; the Toumat River valley; and in the north, in Tigre, in an area southwest of Adua, where quartz veins have been worked by natives and by the Italian Trans-Mareb Syndicate. The syndicate explored 90,000 sq.km. between the Mareb River and Lakes Tana and Ascianghi. Lack of transport stopped the work. Occurrences of gold in Gojjam, Gurage, Shoa, and Wallega were surveyed in 1926. Gold also occurs in Ankober and Gildessa.

Platinum was discovered during the nineteenth century on a tributary of the White Nile, near Yubdo. In 1926, the Société Minière des Concessions Prosso en Abyssinie was organized to work a platinum property in this area. English capital has since entered the company, which is said to have made money and to be building a 200-km. road from Gambella. The concession still has eleven years to run. The metal is sold in London.

Copper has been reported from four districts. A 12-ft. vein running 6 per cent is said to occur in the Ankober district. Cinnabar and asbestos are reported, but without reference to locality; likewise, indications of radium near Dire Daoua. Iron ore is known to exist. Silver is said to occur in Wallega and along the Harrar railway. Coal is produced for local consumption at two places in Shoa province, and other deposits, including lignite, are reported.

Tin and tungsten are said to occur in the Harrar district; mica likewise, the concession for the latter being held by an American company. The mineral also occurs in the Shabella district, near Jig Jigga.

Apatite is said to occur in the Arussi district near Harrar. Close to the Eritrean border is the Assal salt plain, from which potash was produced during the War. This area is the principal source of salt, although this mineral is also mined at various other points.

Sulphur deposits occur in the Howash River valley, in the Harrar district; also in the Erta Ali area, in Dancalia, and on the Dofane volcano, in the Hausac depression.

If there are oil reserves in Ethiopia they are probably in the southeastern area of the country. Preparations seem to be under way for the exploration of this potential producing area. Elsewhere the geology is unpromising.

Recovering Zinc and Vanadium

At the Rhodesia Broken Hill Plant

Concentration, acid leaching, and electrolysis employed in this Central African enterprise

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ON AN EXTENSIVE, sparsely forested plateau, 3,870 ft. above sea level, in Northern Rhodesia, are found the deposits of zinc, lead, and vanadium ores that are being worked by the Rhodesia Broken Hill Development Company. Broken Hill, where the mine office is situated, is 1,328 miles from the port of Beira, in Portuguese East Africa, and 374 miles from Victoria Falls. The entire region stretches for miles in every direction, the surface broken only by small outcrops (kopjes) of the oxidized ores. To the east, some 7 miles away, is a large outcrop of quartzite; about 23 miles beyond this is a 1,000-ft.-deep escarpment, down which the rivers and surplus flood waters of the district find their way to the Luangwa Valley.

Mining by white men is said to have begun in 1895. Information about these times is rather hazy, however, and it is now generally accepted that the mineral area was first found by T. G. Davey in 1902. The discovery was followed up by continuation of construction of what was to be the "Cape to Cairo" railway, of which Broken Hill remained the terminus for some time. With economical transportation facilities available, real mining activities were initiated. Except for shipments of high-grade oxidized zinc ores and vanadium concentrates, the main activity was the production of ingot lead, until, in 1927, an electrolytic zinc plant was brought into operation.

Production of lead from oxidized ore obtained above the 100-ft. level commenced in 1915 and was maintained until around 1924. In 1923, these ores were fast approaching exhaustion, giving place to mixed lead-zinc sulphides at depth. A concentrator was then erected and operated until the end of 1929, when lead production was discontinued, leaving zinc and vanadium the main sources of revenue.

The rocks in which the Broken Hill deposits occur are mainly of two distinct geological periods, the dolomite and slate series resting on more ancient quartz schists. At the mine most of the orebodies occur in massive dolomite within a circular area about one mile in diameter. Below the completely oxidized zone they resolve themselves essentially into a core of lead-zinc sulphides, surrounded by a shell of zinc silicate. Between the zinc silicate and the dolomite walls is a zone of more or less broken ground containing a hard clay, in which the vanadium minerals descloizite and vanadinite occur. Mixed lead-zinc sulphides first appear around the 100-ft. level, above which they are almost completely oxidized. The vanadium minerals are disseminated through the surrounding soil.

In this highly oxidized zone, minerals vary from good iron ore to high-grade zinc and lead ore. The numerous outcrops within the mineralized area contain many types of ore. For instance, No. 2 Kopje outcrop appears to be a zinc-iron deposit (the lead being only a few per cent), and no massive deposits of sulphide have shown up in drill holes which have been continued to 250 ft. from the surface. On the other hand, No. 1 Kopje outcrop contains a large tonnage of high-grade cerussite.

A feature of the Broken Hill deposits is the depth to which oxidation has taken place. When first worked, the normal water level was about 18 ft. from the surface, yet the completely ozidized zone goes down about 100 ft. It is known, however, that the water table has undergone considerable change and the presence of a large cave 60 ft. below the surface, containing considerable evidence of human habitation over many centuries, confirms this belief. The presence of oxidized zinc and vanadium minerals 800 ft. below surface, as disclosed by the deepest drill hole yet put down, is still harder to explain. Considering that the oxidized ores are of secondary origin and are supposedly due to surface oxidation, it is extremely difficult to understand how the surface water oxidation effect would appear at such great depth. However, it must be remembered that the whole area shows ample evidence of subsidence. The fact that an escarpment of over 1,000 ft. depth occurs 30 miles to the east must also be considered.

The oxidized zone is famous for its varied, rare, and extremely beautiful crystallized specimens of zinc ores, the most striking being the various phosphates, of which many unique specimens have been presented to various mineral collections.

As large tonnages of lead, zinc, and vanadium ores occurred above or close to the surface. open-pit mining methods were adopted and still continue. This type of mining has now reached its economic depth limit, and any development below the present working levels must necessarily be by stoping methods. Fortunately, several hundred thousand tons of workable zinc and vanadium ores are above the present water level. (The pumping station is 225 ft. below the surface.) To exploit the lead-zinc

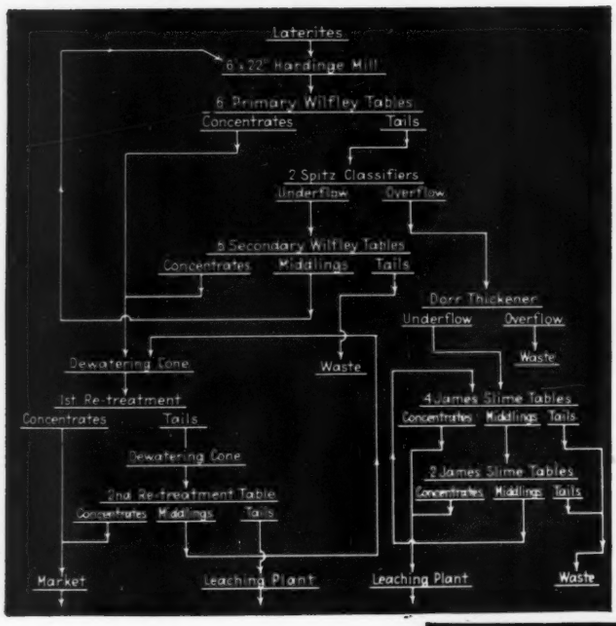


Fig. 1. GRAVITY CONCENTRATION OF VANADIUM ORE

The results obtained are satisfactory, but could be improved, if adequate regrinding equipment were employed

sulphide deposits below this depth, considerable development will be necessary.

The laterite deposits above the 100-ft. level, the source from which vanadium ores are mined at present, are broken and decomposed and resemble a brownish sandy clay. They vary considerably in grade, and a number of faces have to be worked to maintain an even vanadium content of about 3 per cent V_2O_5, mostly in the form of descloizite.

Tramming to the concentrator is done in 16-cu.ft. side-tipping cars. Gravity concentration is used exclusively. Much work has been done to develop a flotation method, but so far without commercial success. The laterites are fed to a standard 72x22-in. Hardinge mill discharging a pulp with 22 per cent (by weight) solids, which goes directly to six Wilfley sand tables, where two cuts only are taken—primary concentrates and tailings. Tailings are pumped to two spitz-type classifiers, the overflow from which runs to a 27-ft. Dorr thickener; the underflow goes to six Wilfley tables, where a secondary concentrate is made. Combined primary and secondary concentrates with about 10 per cent V_2O_5 are re-treated on two Wilfleys, to raise the grade to over 16.5 per cent. The overflow from the thickener is discarded, and the underflow goes to James slime tables (Fig. 1).

Gravity concentration of the vanadium minerals occurring in the laterite deposits is reasonably satisfactory, although better recoveries could be expected with adequate regrinding equipment. Direct-connected Wilfley sand pumps are used exclusively for handling the various pulps. Generally, two products are made—a 16.5 per cent concentrate for shipping, and middlings and slime concentrates with about 8.5

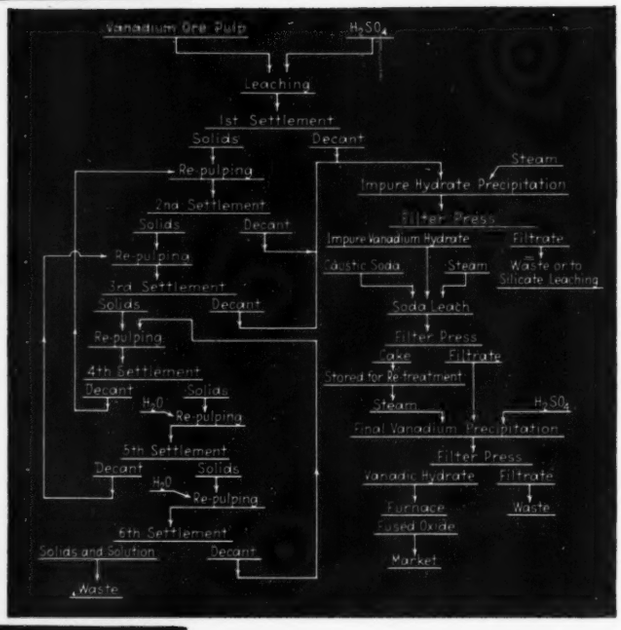


Fig. 2. LEACHING OF VANADIUM CONCENTRATE

The final product is fused oxide (slightly higher than 91 per cent V_2O_5), which is marketed

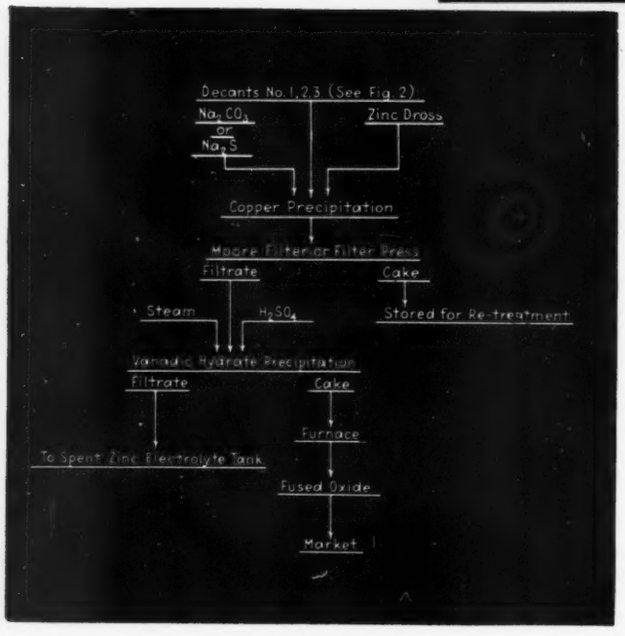


Fig. 3. COPPER AND PHOSPHORUS

are removed thus prior to precipitation of vanadium hydrate. Double precipitation is avoided by this treatment

per cent V_2O_5 for production of fused oxide. For production of fused vanadic oxide the middlings and slime concentrates are ground to minus 200 mesh in a Hardinge mill, pumped to a mechanically agitated wood-stave tank of 20,000-gal. capacity, and mixed with sufficient dilute sulphuric acid to give a solution with 30 to 40 grams per liter V_2O_5. Grinding introduces a small quantity of iron, which reduces V_2O_5 to V_2O_4; it is, therefore, necessary to oxidize with a little manganese dioxide ore during the leach. Flint pebbles would be used were it not for the fact that the mill has to grind other materials for which steel balls are necessary.

Additions of sulphuric acid are made gradually, and cooling coils in the leaching tank prevent the temperature of the solution from reaching 40 deg. C., above which point some vanadium may precipitate in partly insoluble form. Leach-

ing is continued until no more vanadium dissolves, ending with a ratio of free acid to V_2O_5 of about 1:2. At this point three possible methods may be followed.

1. The leach is settled and the clear solution decanted. Weak vanadium solution is added to the tank, which is again agitated and decanted as shown in Fig. 2. This is repeated several times, depending upon the strength of the leach solution, the strength of combined decants desired, and the allowable V_2O_5 content of the final solution to waste. In all cases countercurrent decantation is practiced. Usually, the combined solution going forward to the next step should contain 15 grams V_2O_5 and 7 H_2SO_4. The combined decanted solution is filtered in a wooden filter press and delivered to the precipitation tanks, where it is heated to 90 deg. C. After four hours at this temperature the precipitation of vanadic hydrate is almost complete; the precipitate is filtered in a wooden filter press and fused to oxide, generally slightly above 91 per cent V_2O_5. If the solution contains enough copper or phosphorus to bring these above the allowable sales limit of 0.05 per cent of either in the fused oxide, the hydrate must be purified prior to fusion. This is done by dissolving it in caustic soda or soda ash, filtering in a press, acidifying the filtrate, and precipitating the hydrate in the usual way.

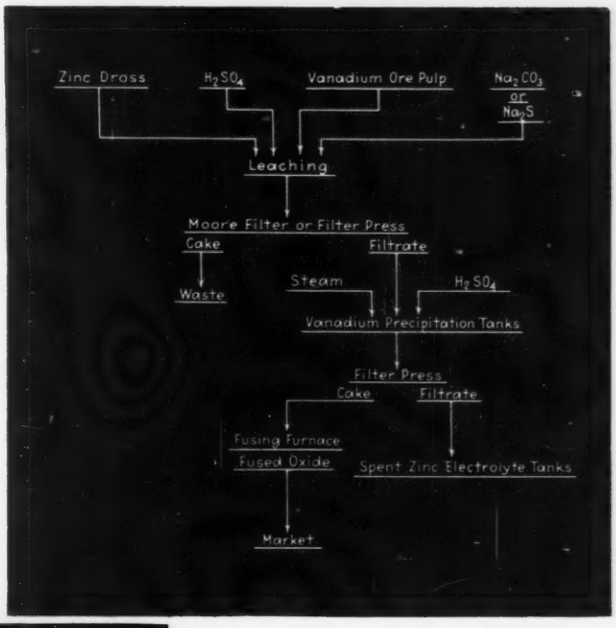


Fig. 4. REMOVAL OF COPPER AND PHOSPHORUS directly in vanadium leach tank. This procedure is followed when tank capacity for the decantation method is not available.

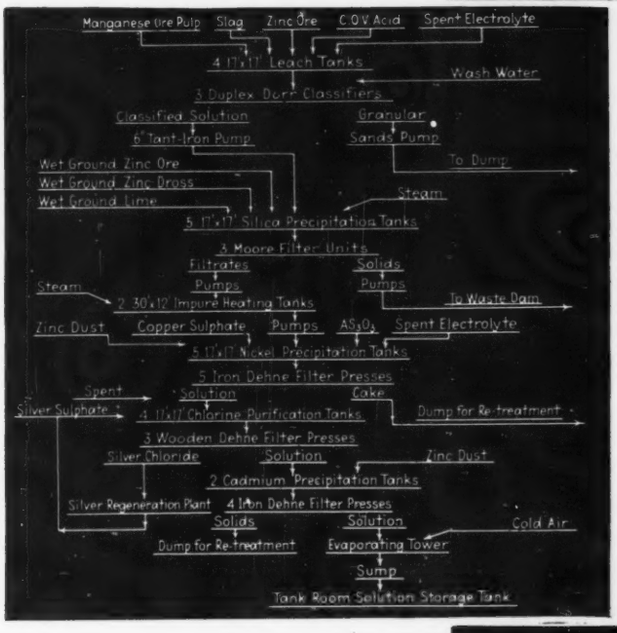
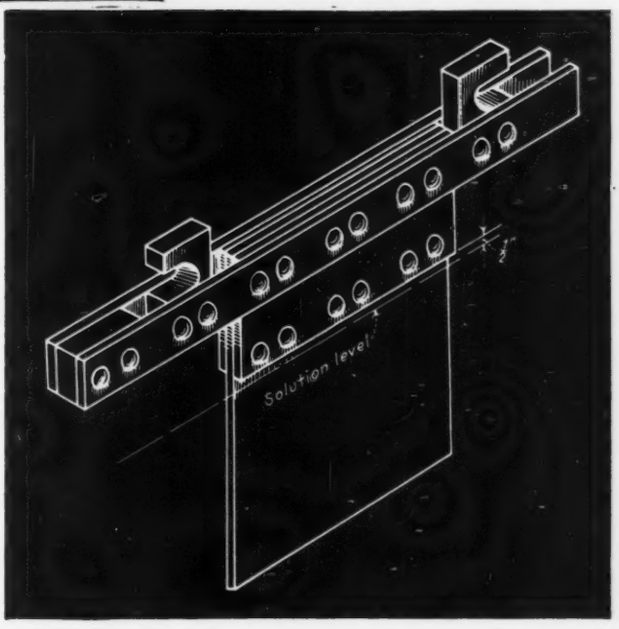


Fig. 5. ZINC ORE LEACHING and purification of leach solutions are conducted as shown in this flowsheet

2. The double precipitation may be avoided by removing copper and phosphorus by adding sodium sulphide or excess soda ash to the decanted solution, prior to the precipitation of the hydrate, after neutralization with zinc dross or lime. The precipitate is filtered off, the solution acidified, and the hydrate precipitated in the usual manner, as indicated in Fig. 3.

3. Instead of decanting the leach, which should contain 25 to 30 grams V_2O_5 and 12 to 15 H_2SO_4, it is neutralized and treated with soda ash or sodium sulphide in the original tank. The pulp is then filtered and the filtrate acidified as indicated in Fig. 4. This procedure is followed only when tank capacity for the decantation method is not available.

When the original laterite contains much zinc silicate this mineral may contaminate the middlings and cause gels during the leaching. The process is then modified to embody a preliminary "silicate" leach, taking advantage of the comparative low solubility of vanadium minerals in anything but fairly concentrated acid. The ore pulp is suspended in water or preferably in the filtrate from the hydrate precipitation (to utilize its content of free acid) and



ALUMINUM CATHODE used in the electrolysis of zinc. Note protection plate at top projecting ¼ in. below solution line

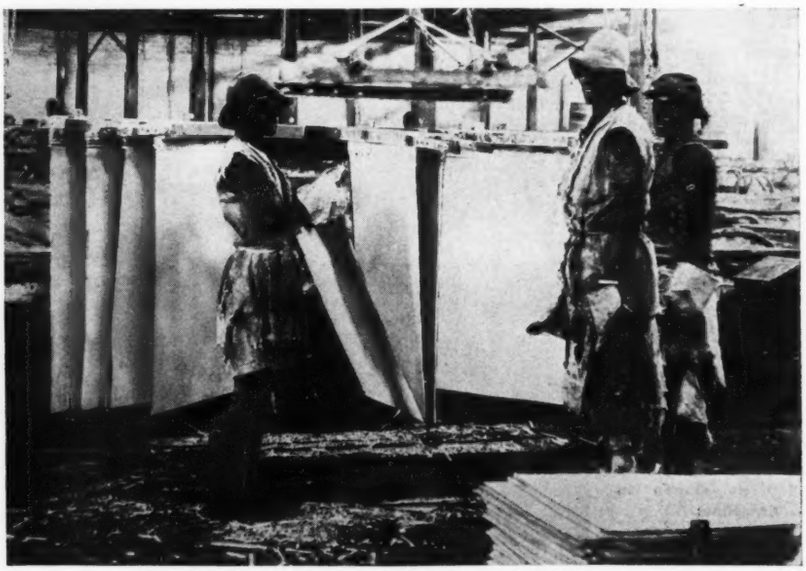
acid is added very slowly to prevent free acidity. A leach may thus be obtained in which only zinc minerals, other than descloizite, are dissolved; settling and decantation, with one decant wash, gives a material free from zinc silicates suitable for vanadium leaching.

Treatment of Zinc Ores

The zinc ore is divided into three classes: coarse, above 3 in.; rubble, below 3 in.; and fines, below 1 in. These are stored separately and are treated as follows: The proportion of each class used is adjusted according to the moisture content, which varies considerably with the seasons. As dry grinding, without preliminary drying, is practiced, it is essential to obtain the ore as dry as possible in order not to slow up the mills. For this reason a considerable ore reserve is accumulated under cover during the dry season, for use with coarse ore mined during the rainy season.

The ore is picked up from the storage, transported to the mill, and dumped directly into the primary crusher, where it is reduced to 6 in. and discharged to a belt conveyor, where waste is sorted out. It then passes through two secondary crushers, in series, and is finally delivered to the fine-ore storage bin at about 1½ in. maximum size. Grinding is done in three Allis-Chalmers ball mills, with adjustable "Commet" feeders, one 6x5 ft. and two 6x6 ft. These discharge into 16-cu.ft. cars, which take the ore to the boot of an 18-in. inclined belt conveyor feeding the leach-plant storage bins. The ore is ground to minus 40 mesh and averages about 50 per cent minus 200 mesh. In operating these mills it has been found difficult to handle ore with over 2 per cent moisture, on account of the formation of water vapor, which, if not removed, may block the discharge diaphragms. For this reason a suction fan is installed at the discharge end of each mill, and the moist air, with its small content of fine dust, is passed through a small washing tower. Solids from this tower are collected, sun-dried, and delivered to the leach storage bins. The three mills have a capacity of 350 tons of ore per 24 hr., with an average ball consumption of 1 lb. per ton. Dry grinding is practiced to keep down the amount of water entering the zinc circuit.

Leaching is done in four wood-stave tanks, 17 ft. in diameter and 17 ft. high, equipped with air-lift columns and two wooden impellers carried on 5-in. rubber-covered shafting to within 2 ft. from the bottom and driven in opposite direction through a crown wheel and pinion, at a speed of 18 r.p.m. Each tank holds 18,500 gal. and is first filled with spent electrolyte and about 2 tons of strong acid. Ground slag is then added to introduce about 2 grams per liter of ferrous iron, which is oxidized with manganese dioxide, an operation requiring about half an hour. The first addition of zinc ore, about 40,000 lb., is then made. After about one hour the acidity is tested and a further addition of ore made if necessary. Analyses of ore and slag in per cent are: Ore—Zn, 25 (completely acid soluble, mainly silicate with a little carbonate); Pb, 6; V_2O_5, 0.7; P_2O_5, 1.5; Cl, 0.12; Fe, 20; insol., 22; CaO, 0.5. Slag—Zn, 13; Pb, 4.5; Fe, 27; insol., 22; CaO, 8; MgO, 1.5; V_2O_5, 1.



CATHODES in groups of ten are taken to the stripping rack by an overhead crawl; the 48-hr. zinc deposit is stripped by native laborers, piled on cars, and taken to the furnace room

The leach, finished at 5 grams free acid, is discharged by a wooden launder to three duplex acid-resistant washing classifiers in parallel, the overflow from which runs into a lead-lined sump and is pumped with a 6-in. tant-iron centrifugal pump to the silica precipitation section. Its analysis, in grams per liter, is as follows: Zn, 100; H_2SO_4, 6; Mn, 10.5; SiO_2, 20; P_2O_5, 1; V_2O_5, 1; Fe, 2. The granular residue is washed by water sprays and pumped from the plant with a 4-in. Wilfley sand pump. It contains 8 per cent zinc (0.5 per cent water soluble).

The classified leach solution with up to 20 grams per liter dissolved SiO_2 is pumped to five 17-ft. diameter 17 ft. high wood-stave tanks, with mechanical agitation and steam jets, where the acidity is reduced to 1 gram by addition of wet ore, ground in strong zinc sulphate solution in a standard 6 ft. x 22 in. Hardinge mill. Mechanically agitated tanks are used for storing a reserve of the various pulps used in this section. The remaining acid is neutralized with zinc dross ground in zinc sulphate, leaving 1 gram per liter excess dross. Lime is then added, the charge is allowed to condition for at least 3 hr. at the desired temperature and is then sent to the Moore filtering section. In this operation vanadium and phosphorus are precipitated by the iron, the excess iron comes down as ferric hydrate, and the silicic acid passes through the hydrosol, hydrogel, and granular stages.

Conditioning the pulp is the most important step in the Broken Hill process, for on this depend the results obtained in the subsequent filtration step. All charges are tested by color indicators before they are passed through the section—the standard being pH 4.0 to 4.5. Practical filtering tests are also made on the pulp, to measure the conversion of the gelled silicic acid into the granular form.

There are three four-basket Moore filter units, each consisting of one filtering tank, four wash tanks, and one discharge tank, all 30x12 ft. and 10 ft. deep, of reinforced concrete, lined with lead. Overhead Morris electric cranes, one to each unit, are used to carry the baskets from tank to tank. A central vacuum system employing Rees-Roturbo pumps serves all units. Each basket has 40 leaves, a total filtering surface of 4,000 sq.ft. The leaves consist essentially of wooden frames covered with twill canvas. A lead pipe inside the canvas cover, passing from top to bottom, connects to the vacuum header pipe and carries away the filtrate to two heating tanks equipped with lead steam coils. Here it is heated to 70 deg. C. and pumped to the nickel purification section, five lead-lined wooden tanks, 17 ft. diameter and 17 ft. deep, with mechanical agitation, covered and connected to a suction fan to prevent noxious fumes from being dispersed in the building.

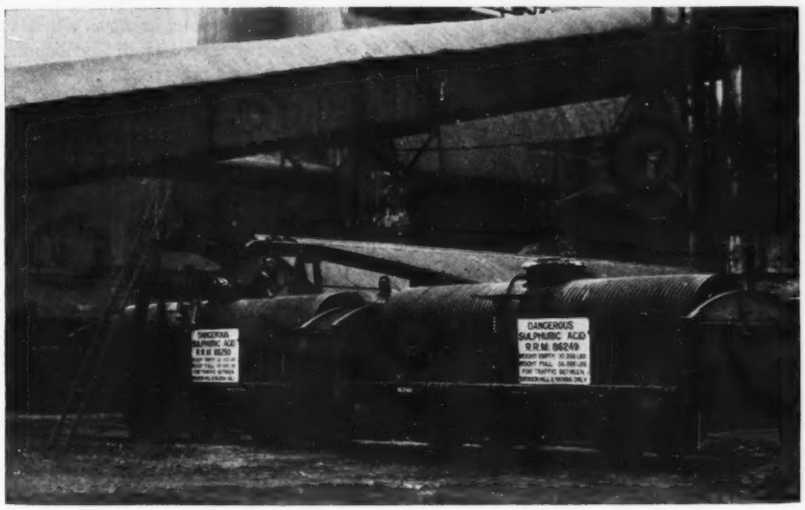
A charge, consisting of 18,500 gal. of impure solution with 10 to 15 mg. of nickel per liter, is first agitated with cop-

per sulphate (10 to 20 lb. Cu) and sodium arsenite (5 to 10 lb. As_2O_3); spent electrolyte and 200 lb. zinc dust are added and agitation is continued about 2 hr. The charge is then tested for nickel by a special dimethyl test; if the content is below 0.2 mg. the solution is filtered through four iron Dehne filter presses and sent to the chlorine removal section, where it is treated with acid and silver sulphate to reduce the chlorine from about 100 to 20 mg. per liter. The solution is decanted, filtered through three wooden filter presses, and sent to the cadmium-removal section, and the precipitated chloride is reduced by addition of strong acid and zinc dust. The resulting cement silver is converted into silver sulphate and re-used.

Zinc solution leaving the wooden filter presses, containing about 100 grams per liter zinc, 0.1 H_2SO_4, 20 mg. chlorine, and 15 mg. cadmium, flows by gravity to two lead-lined steel tanks, in series, mechanically agitated; zinc dust is added to the first tank at the rate of 0.4 grams per liter. Solution and precipitate flow from the bottom of the first tank to the top of the second and are drawn from the bottom of the last tank by a centrifugal pump and forced through iron Dehne presses.

The zinc solution leaving the cadmium presses is delivered to the top of an evaporating tower, 12x12 ft. square, 30 ft. high, with two 10,000 cu.ft. per minute pressure fans delivering air to the base of the tower. Wooden slats spaced every 6 in. distribute the descending solution evenly. The solution entering the tower has a temperature of 60 deg. C. and a zinc content of 100 grams per liter. Leaving the tower, it analyzes 103 zinc and the temperature has dropped to 34 deg. It goes to a sump and is pumped to two 12 ft. high, 50 ft. diameter lead-lined wooden storage tanks feeding the electrolyzing cells. Normally, the pure solution is pumped to one tank and overflows to the other, from which it flows by gravity to the tank-room solution header. Addition of glue is made ahead of the first tank to insure perfect mixing.

The cell room contains 144 lead-lined cells divided into two units with twelve cascades of six cells each. Lead lines over and between each double cascade deliver the pure solution to the individual cells. Spent electrolyte from the bottom cell of all cascades runs through a main launder into two spent storage tanks of similar size and construction as the pure-solution storage tanks. Cells are built of 4-in. Oregon pine lined with 8-lb. lead, the inside dimensions being 16x3x5¼ ft. A lead-covered steel frame serves to keep the timber rigid; this is further reinforced by a central lead-covered bracing bar just below the solution level. Each cell has 42 anodes, 40 cathodes, and 4 cooling coils. The busbar, resting on porcelain insulators, consists of a number of sections of rolled copper, riveted together.



UNLOADING strong sulphuric acid used in leaching zinc ores—Operations are carried out with native labor, supervised by white foremen. The results are said to be satisfactory

Cell characteristics are as follows: Load on busbar, 18,000 amp.; current density, 29 amp./sq.ft.; voltage, 3.55; temperature of solution, 38 deg. C. (40 deg. max.); of cooling water, 25 deg. in, 28 deg. out; spacing 4¼ in. centers; time of deposit, 48 hr.; feed, in grams per liter, 103 Zn, 11 Mn, 0.20 Cl, 0.005 Fe, and Ni, Cd, and As a trace; spent electrolyte, 40 Zn, 95 H_2SO_4, 10 Mn.

Cathodes are made from $\frac{3}{16}$-in. hard-rolled aluminum sheets 27 in. wide and 45 in. long (41 in. submerged) riveted to 1½x¼-in. copper header bars. A protection plate of aluminum is fitted on each side of the cathode and is held by the copper header bars at the top and by aluminum rivets at the bottom, as shown on p. 491. This plate projects ½ in. below the solution level to prevent excessive corrosion of the sheet. Rubber strips on the edges prevent growths and facilitate stripping. Anodes are made of local lead, cast around a ⅜-in. copper header bar, with rounded corners; they are 25 in. wide, and project 38 in. into the solution.

The cathodes are lifted in groups of 10, after 48 hr. deposition, and taken by overhead crawls to racks, where the zinc is stripped and the cathodes are inspected before returning to the cells. The stripped metal is weighed and taken to the melting division. A current efficiency of 91 per cent is common practice. Removal of anode mud is done with the cells in operation. About one-fourth of the electrodes are lifted out and the manganese mud is taken out with long-handled scoops. This work is done with a good deposit of zinc (24 hr.) on the cathodes, as it has been found that with this condition the impure anode mud stirred up causes less resolution of the cathodes.

As the high content of calcium sulphate in the feed causes rapid coating of cooling coils, these must be cleaned constantly. This is done according to a schedule which allows all coils to be cleaned once every seven days. The high initial temperature of cooling water makes the heat transfer a serious problem, and only constant attention to coil cleaning will insure a cell temperature of 40 deg. or under. Altogether, about 4,000,000 gal. of cooling water is used every 24 hr.

Cathode zinc is fed directly to a 125-ton reverberatory furnace; two 8-hr. shifts easily handle the plant output of 63 to 65 long tons of cathodes per day. Charging is done in three lots over the two shifts. Immediately after each feed, the zinc dross formed is rabbled and treated with sal ammoniac (1 lb. per ton cathodes) and finally withdrawn from the furnace. About 5 per cent of the cathodes is dross. Coal consumption is 4 to 5 short tons a day.

Molten zinc is tapped into pouring pots holding about 600 lb. of metal. From these pots it is poured by hand into the ingot molds. All zinc is cast in 56-lb. slabs, stamped with the date and bearing the impression of the head of a sable antelope, the company's trademark. Overseas shipments are made from the port of Beira, in Portuguese East Africa. "Sable" brand zinc averages approximately: zinc (by difference), 99.9815 to 99.9775 per cent; lead, 0.016 to 0.018; iron, 0.0010; copper, 0.0005; cadmium, 0.001 to 0.003; arsenic or other materials, nil. Part of the output is converted into debased zinc for the galvanizing industry, by the addition of 0.5 to 1.0 per cent lead. This metal is marketed under the trade name "Sablon."

The dross is dumped and screened to remove coarse metallics. Fines are charged into a rotary calciner, the product from which is used in the silica precipitation. Operations are carried out with native labor.

Arroyo Seco's New Dredge

At Ione, Calif., Develops Large Capacity In Proportion to Its Size

Sectionalized hull facilitates erection . . . Welding turned to advantage in construction of the spud, the save-all, revolving screen, and distributor

John B. Huttl
Assistant Editor

SEVERAL NEW DETAILS of construction aside, that feature its design, the new bucket dredge of the Arroyo Seco Gold Dredging Company, which recently began digging about 2½ miles west of Ione, Calif., is noteworthy for the speed with which it was erected and for the yardage it handles in relation to its size. Seventy-five days after the preliminary work was started, on Feb. 25 last, it was ready for service. This was on May 10. Since then, moreover, it has frequently dug and treated 7,300 cu.yd. of gravel per day without forcing the equipment, although its capacity was originally rated at no higher figure than 140,000 to 160,000 cu.yd. per month. The buckets are of 6-cu.ft. capacity.

This remarkable digging performance is ascribed to the proper design and selection of the gravel-treating and power equipment. The speed attained in erection is credited to the sectionalized construction of the hull and superstructures. A maximum weight per piece was used which was within the load-carrying capacity of the available trucks. Departures from standard dredge construction are to be found in the use of a welded spud, save-all, revolving screen, and distributor of special design.

The dredge is built entirely of steel, including the hull, trusses, gantries, and housing, and has a digging depth of 32 ft. It is electrically driven, the power being obtained from the high-tension line of the P. G. & E. Company and stepped down to the desired voltage by a series of transformers. The hull is constructed by bolting together nineteen steel pontoons, which make the hull unit 88 ft. long, 40 ft. wide, and 7 ft. deep. Each pontoon is of welded, watertight construction, consisting of steel plates and angles, stiffened by bracing so as to form a rigid unit. Of similar construction are the various sectionalized superstructures and frame housing covered with galvanized iron sheets. Connections are made with bolts.

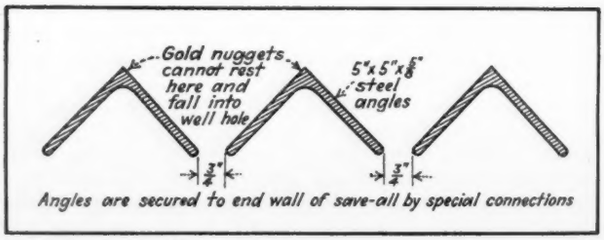
Upon closer inspection of the hull another new feature is evident to the visitor—namely, the bow corners of the hull have been cut back at a greater distance than is usually the case. This has been done so that the dredge may dig closer into the bank, with the result that time lost is decreased to a minimum, as no change of position of the dredge is required and all necessary bedrock can be dug.

Both the bow gantry and the digging element are of standard design. The latter consists of a ladder of the plate-girder type measuring 82 ft. between tumblers, the upper and the lower tumbler and the bucket line proper being composed of 82 closely connected 6-cu.ft. buckets. In view of the comparatively shallow digging depth, no bucket idler is required in the well hole. The buckets are of manganese steel with two spill wings below the bucket lips, as shown in one of the accompanying cuts, which reduce spillage to a minimum. The lower tumbler is of manganese steel, the upper of nickel steel, and both units are keyed to respective nickel-steel shafts. Wearing plates are welded to the tumbler body. Bucket pins are made from nickel-chrome steel, forged and heat-treated, and are 4 in. in diameter. Both bearing ends of the lower tumbler shaft are provided with two pressed-on steel rings which fit loosely into the grooves of the bearings proper in order that grease may pass in between. The play between the ring and groove is about ¼ in. This arrangement obviates waste of grease and assures perfect lubrication of the bearings. The thrust experienced on both ends of the lower tumbler shaft is taken up by special disk bearings. The rollers on the digging ladder, too, are fitted with special grease retainers. Alemite fittings are used on the dredge wherever possible.

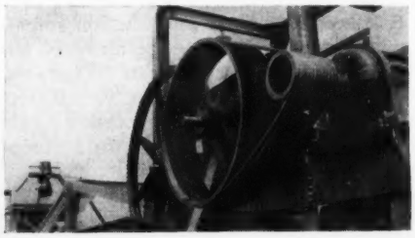
The drive mechanism on the digging element differs considerably from that used on other dredges. In this case the 100-hp. motor driving the bucket line only is mounted on the main drive girders, to do away with the conventional long-center belt drive. The gear arrangement consists of two large machine-cut spur gears keyed to the upper tumbler shaft, two bull pinions

SPILL WINGS placed below the lip and cast integral with the body are a feature of the 6-cu.ft. manganese-steel buckets used on the new dredge

SHORT-CENTER DRIVE of the digging ladder, close up. Power is transmitted to the upper tumbler by an unusual arrangement of gears and pinions


Gold nuggets cannot rest here and fall into well hole
5"x5"x⅝" steel angles
¾"
¾"
Angles are secured to end wall of save-all by special connections

STEEL-ANGLE GRIZZLY used in the save-all is arranged in this manner. This construction assures a free flow of material through the ¾-in. openings.



DIGGING GOLD near Ione, Calif.—The new dredge at work, as seen from the air. Since it was placed in service a few months ago it has displayed a capacity greatly exceeding its rated yardage

ARROYO SECO'S NEW DREDGE has several interesting features of design. Here can be seen the V-belt drive of the digging ladder and the extent to which the bow corners are cut back to facilitate working close to the bank

and a single gear on the intermediate shaft, and a pinion fitted with a friction clutch on the drive shaft. Power is transmitted through a short-center Worthington V-belt drive.

Discharge from the buckets is received in the main hopper just below the upper tumbler. This unit, built of plates and angles, welded instead of bolted or riveted, is of standard design. The steel save-all provided to catch all material escaping the main hopper also is welded. Here a distinct departure from usual practice is the use of steel angles in place of the conventional grizzly bars to classify the material received. As shown in the accompanying sketch, these are spaced $\frac{3}{4}$ in. and measure 5x5x$\frac{5}{8}$ in. They are bolted to the end wall of the save-all by special connections. Absence of tie rods and the hopper-like discharge openings assure a free flow of material through the $\frac{3}{4}$-in. openings. In addition, gold nuggets falling upon this grizzly cannot possibly return to the well hole, for the inclined surfaces of the angle bars will direct them immediately through the openings and to the revolving screen.

From the main hopper the gravel flows by gravity into the revolving screen, 6 ft. in diameter and 31 ft. long. The screen section is 22 ft. 6 in. long. Screen plates are of manganese steel, with perforations $\frac{3}{8}$ to $\frac{1}{2}$ in. and $\frac{1}{2}$ to $\frac{5}{8}$ in. The lifting bars are cast to the screen plates instead of bolted, as is usually the case. This feature is new. The screen unit proper is of all-welded steel construction and is driven by a speed-reducer unit powered by a 40-hp. motor. Screen oversize or tailings fall upon manganese-steel bars used for lining, which discharge directly onto the stacker belt. This is 30 in. wide and of seven-ply rubber, with a ribbed surface to prevent the sands from running backward. The stacker ladder is 84 ft. in length and is suspended and operated from the stern gantry.

One unit that was changed radically in parts from standard practice is the welded all-steel distributor. It is built on the order of a rectangular trough inclosing the lower part of the revolving screen. Apart from several doors provided with locks and water connections, the distributor contains two incline tables, the uppermost being fitted with a short length of rubber matting at the intake end of the revolving screen and Hungarian riffles, whereas the lower table has riffles exclusively; two arched steel baffles, and a special distributor launder with steel baffles and gates connected to the gold tables. With this arrangement the undersize from the revolving screen flows first over the upper table, is then directed to the lower table by the arched baffle at the end of the first table, and finally is forced into the distributor launder by the arched baffle at the lower end of the second table. About 80 per cent of the gold particles is recovered on the first table. Steel baffles welded to the interior of the distributor, leaving only a small space between the screen shell and the sides of the distributor, make impossible the removal of gold from the tables and launders.

The system of gold-saving tables arranged on either side of the revolving screen consists of seven sluices each 2 ft. 6 in. wide, and two tail sluices 3 ft. wide. Each sluice is equipped with standard Hungarian riffles and mercury traps. Total sluice area is about 1,500 sq.ft. The tail sluices discharge into a common sump, from which the sands are elevated by a bucket elevator discharging through a special chute upon the stacker belt. The sand elevator and the stacker belt are driven by a 7½-hp. and a 20-hp. reduction-gear motor respectively.

Considerable attention has been given to the selection and installation of the winch equipment. On this dredge the diverse hoisting and swinging operations are performed by a combination ladder hoist and a swing winch driven by a two-speed motor. This unit contains one drum for the digging ladder, two drums for the bow lines, two for the stern lines, one drum for operating the spud, and one spare drum.

All brakes and clutches are controlled by a Westinghouse air-brake system. The motor operating the winch develops 60 hp. when running at 1,200 r.p.m. and 30 hp. at 600 r.p.m. Motor speed is reduced by cutting out half the number of poles. The full power, or 60 hp., is used when raising the digging

ladder or spud, and 30 hp. when swinging the dredge. This equipment has proved most satisfactory from a standpoint of first cost and power consumption.

The spud is 20x32 in. in section and 45 ft. long. It is of all-steel construction, welded, and extra material was placed where necessary and where the greatest strains occur. Lifting accessories are suspended from the stern gantry.

Pump equipment is as follows: one 10-in. centrifugal for high-pressure service; one 8-in. centrifugal for low-pressure service; and one 4-in. spare unit. All are of Byron Jackson make, and are direct-connected to a 60-, 20,- and 15-hp. motor respectively. The motors used on the dredge are of General Electric Company manufacture. Pump intakes are covered with screens to prevent floating trash from entering the pump chambers.

The housing, including the roof, is made of steel panel sections bolted together in the field. A large number of windows have been provided to make the interior of the housing as light as possible. At night floodlights installed at suitable points give sufficient light to make operation efficient and safe.

The dredge was designed by the engineers of the W. W. Johnson Company in San Francisco. At present they are finishing the design of an 8½-cu.ft. electric dredge to be erected at Loomis, Calif., a 2½-cu.ft. electric unit for Comanche, Calif., and a 4-cu.ft. diesel dredge to work on Coal Creek, Circle district, Alaska. The latter is expected to be in operation early in 1936.

Wake Up, Placer Operator!

Learn Something From Lode Gold Sampling and Recovery Methods

Loss of fine gold in the past has been huge, thanks to the bland assumption that one pass through a sluice box, or its equivalent, gives a reasonable recovery

James M. Hill
Geologist
Berkeley, Calif.

MANY YEARS' EXPERIENCE in the examination of both lode and placer mines leads me to make the attempt to reconcile the practice of lode gold miners with that of placer miners. Each has his particular manner of sampling and estimating "ore" and each a method of saving the valuable metal. Those of us who have had to cut samples know that in the instance of quartz deposits we take as many samples as we think our clients will permit, and the more the better, where we have to deal with free gold; yet the placer miner, particularly the dredge operator, is content with one drill hole to every four to ten acres, and, for exceptionally close work, one hole to every acre. Think of that and weep, you hard-rock men: for the very best placer prospecting, 1 to 141,982 where a 6-in. drill pipe is used, and this is general in all but tropical exploration work; and 1 to 384,093 where a 4-in. casing is used. Would any quartz man care to estimate a block of ground containing 141,982 cu.ft., say 10,000 tons, on the basis of one small sample? He would be considered foolish. That is what the placer engineer is accustomed to doing, and he has made some remarkably good guesses, for that is all they really should be called. Very intelligent guesses they are, to be sure, based more on the wide personal experience of the engineer in charge rather than the drill results of even the most experienced crew, and with a panner such as we dream about but only occasionally find.

Another great contrast between the lode gold miner and the placer miner is that the latter insists that a one-step operation — namely, running gravel through a pan rocker, or sluice—will and must catch all his values, irrespective of the size of those particles and also, alas, in most instances, irrespective of whether those values are actually free or not. What I am getting at is this: The present practice in placer examination provides little information as to more than a general idea of either the size of the gold particles or their distribution in the gravel. True, the panner records by number the size of the gold he saves, but, after all, what is a No. 2 color? To one man it is ⅛ in. in size and to another it may be only 1/16 in. In the work I have seen, size scale means next to nothing except for a particular job or body of gravel. And that is logical from the placer standpoint too. For why should one go into refinements of sizing when actual mining and saving will be done as it will be?

Now for the other side. In metallurgical testing of gold quartz the customary practice is to grind and screen to various sizes and ascertain where and in what form the gold occurs. Once that is established one can readily work out a flowsheet which will save as much of the gold as is economically possible.

My contention is that the placer miners are overlooking a real thing. Possibly they have been too busy with their own problems to realize that the metallurgy of gold has not stood still. On the contrary, the metallurgy of gold is a lusty, growing child which every day adds to its stature. The dredge industry—the most progressive of the clan of placer miners—has made only one major improvement in the recovery process since it started in 1898. That was the installation of the Neill jig as long ago as 1916. To be sure, better tables have been made, and recently better jigs, but the one-track system seems to be ingrown or hereditary in the placer game. The hydraulic miners are just as bad. Even the best of them smile and look sorry for you when you mention the possibility of their losing fine gold. And they go on merrily using sluices, and a few of them undercurrents, and all of them sending from 10 to 60 per cent of their gold to the dump, because they do not have time, perhaps, to take a sample of their tailing to find out how much fine gold is contained in the gravels they are working.

Most geologists, I think, will agree with me that in the nature of things the erosion of a lode gold will produce a certain amount of finely divided gold; the quantity of fine gold will, of course, be dependent on the size of the gold in the quartz or lode deposits. Equally

certain is the fact that much gold in many parts of the world is in very fine particles intergrown with sulphides. Recent studies made in both public and private metallurgical laboratories, whose results have been made available by the technical press, indicate that, in most quartz mills, to grind very fine is advisable if a good extraction is to be expected. Also, more clearly becomes the impression that good gold-mill practice necessitates the treatment of differently sized products in various ways, but always bearing in mind that the prime object of it all is to catch that gold as soon as possible and with as little crushing as possible. If that is good for the quartz miner why is not such a practice equally good for the operator of a placer mine?

Faulty Beliefs

The difficulty with the placer miner is that he has been taught, and has inherited the belief, that to move dirt he must use vast quantities of water. Perhaps that is true, but other industries are moving large quantities of very low-value products at extremely low costs, and I have a suspicion that the placer miners might benefit by taking a little time out and looking into some of these methods. Shovel and dragline costs have been published recently that make the costs of moving gravel by "water under pressure through a nozzle" look rather sick. Well, the placer miner will say, "How about dissolving the clay and breaking down cement?" The Georgia and Missouri barite miners have been doing that for years for a product that sells for around $8 per ton (ton, not ounce), and machines are in use in the iron mines in the Lakes region that do both of those things extremely well and at remarkably low cost. But the worst is the last. How can one possibly expect to save minus 200-mesh gold and nuggets up to an inch in diameter in one single piece of crude apparatus, which the sluice surely is? Yet that is what the placer miner has been doing for years and still is doing, and which, he will do for a long time yet, as he is a hard bird to change in his ways. The quartz miner was hard to change, too, but that change has been accomplished. Such mines as those of the Mother Lode at Jackson and those at Grass Valley have finally come to the use of flotation and are thereby reaping a fine harvest. The technical press is full of data on the latest mill flowsheets, and an interesting feature is that all of them are working to the same end, to get the gold as quickly and with as little grinding as possible. More recent articles even mention a flotation cell directly following a ball mill and before the classifier.

Unquestionably, flotation will save extremely fine gold. Too much fine work by excellent men has been done, and the results have been published, to permit any question of that. The next question is: Can flotation be successfully applied to placer mining, and, if so, what will it cost, and what will it mean in dollars to the man who plays the game? The answer to the first part of that question is "Yes," and "Much" to the latter part. Even in many of the present set-ups for hydraulic and drift mine work, to put in equipment to handle the waste tailing would pay.

Anyone contemplating a new installation is in my opinion overlooking a very important thing if he does not have the gravels examined with a view of learning whether enough gold exists in very small size to make its recovery pay. The answer to that question nine times out of ten, or, rather, 99 in every 100, will be: "Yes. Much gold exists that is minus 20 to minus 400 mesh, and most of it can be saved by flotation."

My own experience during the past two years has shown that the value per yard can be increased from 10 to as much as 200 per cent by saving the flour gold that would be lost in the usual placer set-up. And do not forget that by set-up I refer not only to hydraulic and sluice mines but to the dredges as well. The changes to be made in the usual hydraulic set-up are relatively simple and surprisingly inexpensive, considering the returns that are possible. On one property I have examined with particular care I believe that an investment of $11,000 for plant will produce a net return of more than $100 a day after paying a rather high royalty of 15 per cent on the gross output. This is a small operation, only 500 yards a day, but the values of the gravel are good, the ground is easily workable, and conditions are ideal. The little plant for this mine has been designed to go on skids, but it could as well be on a barge. The machinery consists of screens, flotation cell, sluices to handle the coarse sands, and an engine to run the plant. All weighs less than 5 tons and is mounted on a 12x24-ft. platform.

Sampling Technique Must Change

A great difference prevails in methods of sampling a deposit of placer gravel if one is trying to really find out how much gold, including fine-sized gold, exists, or just wishes to know how much gold might be saved in a sluice. The time and care in the former instance are not so much greater than in the latter, but the technique is entirely different, and the results often vary surprisingly even to one who has been doing that sort of thing for months. For instance, just as illustration: I sampled one place, washing two pans of dirt from a surface cut by the pan, and recovered 34c. per yard, figured back to bank measure and at $20.67 per ounce. A sample taken for flotation test from the same hole and depth and exactly the same quantity of gravel returned $5.34 per yard. Had you seen the flotation concentrate you would have known why. The gold was so fine that it was almost impossible to distinguish individual particles in the flotation concentrate with the eye. I was convinced that practically all the gold was minus 150 mesh and some of it under 300 mesh. I have floated sand which produced a concentrate that showed almost no visible gold and yet would give a good button when assayed. The flotation of course saves platinum metals and any sulphides present, and do not forget that in places these sulphides are rich.

A Change Pending

I sense a gradual change taking place in the minds of dredge operators, and believe they will before long be willing to discuss their metallurgical problems on a rational basis. Heretofore they have insisted to the world that they were not losing fine gold, that their recoveries were very high, and that they knew all about what they were doing. I have noted a change recently. It seems to me that the dredge men are not quite so sure that they know even how much gold the gravel which they are digging contains, and I feel certain that several of them are willing to admit that dredge metallurgy is not all that they have claimed for it in years gone by.

I recall very distinctly the good-natured "calling of the kettle black" that took place about 1921 between the prospecting and operating members of that famous Dredge Operators Association. Much of this material was published in the *Mining and Scientific Press* and *Engineering and Mining Journal*. Gardner gave the most complete data in Vol. 122 of *E. & M. J.* Many valuable papers were presented, all of which left the impression that the men in the business were not satisfied with what they were doing, but could not get on the right way to learn more about their gravels and metallurgical problems.

Flotation has, in my opinion, made possible not only much greater recoveries from dredgable ground than now prevails, but also will make possible the working, and possibly the reworking, of large areas that have been passed up, or over, in years gone by, because no way existed of knowing how much gold those gravels contained, nor of recovering it had one been able to estimate the value of fine gold. Personally, I expect to see very rapid changes in the technique of placer sampling, the slow change of metallurgy at hydraulic mines and on the dredges, and ultimately a greatly expanded area of operation. My own thought is that the changes on the dredges will tend to reduce first cost, reduce space required, and considerably reduce the cost of water. The recoveries, which I believe are now 60 to 75 per cent, will be raised to 90 or even 98 per cent, as in gold-quartz mills where recent metallurgical advances have been adopted.

Further Tests in Flotation Of Free Gold

Effect of amyl xanthate and pulp pH on recovery is studied . . . Acid wash to remove chemical films has beneficial result . . . Tests should be run with checks

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WIDESPREAD EXCHANGE of information concerning the flotation of free gold as the means of bettering the understanding of problems arising in the expanding treatment of gold ores by flotation was suggested by L. H. Lange in the March, 1935, issue of *Engineering and Mining Journal*. Data as to the results obtained with various collecting and pulp-conditioning reagents in particular are desired in order that a workable theory be formulated that would serve as a shortcut to the solution of problems not satisfactorily solved today.

In this article are presented the results of a series of flotation tests showing the effect of amyl xanthate and the pH of the pulp on the recovery of placer gold. As all the obtainable material was very low in grade, it was necessary to pre-concentrate by gravity prior to testing. The gravel was concentrated on a Wilfley table; subsequently the black-sand concentrate was passed through a 65-mesh screen, the undersize being used as flotation feed. Five hundred grams of this material, with the necessary reagents, were conditioned for five minutes and then floated for ten minutes in a Denver 500-gram laboratory flotation machine of the sub-aeration type.

For these tests the placer gravel was obtained from the same locality, but at two different times, each lot being pre-concentrated, separately, prior to testing. The gold in the material used for the first series of tests (Tests 1 to 7, Table I) was readily floated with terpineol and xanthate (Tests 4 to 7, Table I), but the gold recovery obtained by performing a similar test with the material used for the second series (Tests 8 to 22, Table II) was very low (Test 17, Table II). This discrepancy could possibly be caused by the precipitation of salts on the surface of the gold resulting from the evaporation of the water, as the material used for this second series was obtained in the dry season of the year, when all the small streams were practically dry.

Practically no concentration of gold is effected if terpineol is the only reagent used (Tests 1 to 3, Table I). Tests 4 to 7 show that a very marked increase in recovery is accomplished by the addition of amyl xanthate in varying amounts in conjunction with terpineol in the amount of 0.10 lb. per ton.

In investigating the effect of the pH on gold recovery, potassium amyl xanthate and terpineol in constant quantities of 0.10 lb. per ton, each, along with various amounts of pH modifiers, specifically sulphuric acid and sodium hydroxide, were used.

Each test was run in duplicate to prevent so far as possible erroneous conclusions being drawn from erratic results. The gravel used in these tests, although obtained from the same locality as that employed in the previous series of tests, was of much lower grade.

A very low gold recovery was obtained when no conditioning agents were used (Test 17, Table II). The recovery was also very low when small

Table I—Effect of Amyl Xanthate on the Recovery of Placer Gold

No.	Lb./Ton Terpineol	Lb./Ton Potassium Amyl Xanthate	Assay Tailings Oz./Ton	Gold Content of Total Concentrates, Milligrams	Calculated Assay Heads[1] Oz./Ton	Per Cent Recovery
1	0.50	None	0.42	0.005	0.416	Nil
2	1.00	None	0.32	0.005	0.326	Nil
3	2.00	None	0.38	Trace	0.375	Nil
4	0.10	0.03	0.035	3.66	0.267	73.5
5	0.10	0.06	0.045	3.97	0.276	84.4
6	0.10	0.25	0.025	5.52	0.346	93.0
7	0.10	0.50	0.015	4.13	0.256	94.0

[1]Calculated heads derived from concentrate and tailing assays and weights.

Table II—Data Obtained by Varying the pH of the Pulp

No.	pH	H_2SO_4 Lb./Ton	NaOH Lb./Ton	Weight Concentration, Grams	Ratio of Concentration	Tailings Assay, Oz./Ton	Gold Content of Total Concentrates, Milligrams	Calculated Heads Assay, Oz./Ton	Per Cent Recovery
8-1	3.0	10.000	.....	2.20	227	0.060	0.055	0.063	5.0
2	3.0	10.000	.....	2.10	238	0.035	0.030	0.037	4.9
9-1	4.0	6.000	.....	2.00	250	0.055	0.055	0.058	5.6
2	4.0	6.000	.....	2.00	250	0.070	0.070	0.074	5.6
10-1	6.8	5.000	.....	2.10	238	0.020	0.770	0.066	70.0
2	6.8	5.000	.....	2.26	221	0.030	0.175	0.041	74.0
11-1	7.6	0.800	.....	2.67	187	0.020	1.060	0.084	76.0
2	7.6	0.800	.....	2.32	215	0.025	1.090	0.091	73.0
12-1	7.6	0.400	.....	2.68	187	0.010	0.570	0.044	77.0
2	7.6	0.400	.....	2.82	177	0.030	1.730	0.133	76.5
13-1	7.7	0.200	.....	2.85	175	0.010	1.190	0.082	87.9
2	7.7	0.200	.....	2.62	191	0.010	1.030	0.066	93.8
14-1	7.7	0.100	.....	2.58	194	0.015	1.100	0.135	89.0
2	7.7	0.100	.....	3.14	159	0.010	1.500	0.110	90.5
15-1	7.8	0.050	.....	1.55	323	0.075	0.070	0.079	5.3
2	7.8	0.050	.....	1.58	316	0.070	0.075	0.075	6.0
16-1	7.8	0.025	.....	1.68	298	0.110	0.065	0.115	3.4
2	7.8	0.025	.....	1.66	301	0.115	0.030	0.112	1.6
17-1	7.8	.....	.....	1.56	320	0.055	0.050	0.058	5.1
2	7.8	.....	.....	1.51	330	0.045	0.060	0.061	7.4
18-1(a)	7.8	.....	.....	2.40	210	0.012	0.860	0.063	81.5
2	7.8	.....	.....	2.30	218	0.012	1.000	0.072	83.0
19-1	8.2	.....	0.500	2.00	250	0.030	1.310	0.108	72.4
2	8.2	.....	0.500	2.40	210	0.025	0.760	0.070	65.0
20-1	8.8	.....	1.000	2.00	250	0.015	0.980	0.034	80.0
2	8.8	.....	1.000	3.00	167	0.050	1.200	0.122	79.5
21-1	9.2	.....	2.000	2.20	218	0.010	0.930	0.066	85.0
2	9.1	.....	2.000	3.50	143	0.010	0.820	0.059	83.0
22-1	10.4	.....	4.000	2.50	200	0.005	1.330	0.035	94.5
2	10.4	.....	4.000	2.10	240	0.005	1.110	0.072	93.0

(a) Cleaned with sulphuric acid before floating.

Fig. 1—SULPHURIC ACID, when added to the pulp in the quantities shown, had the effect indicated by this graph, plotted from tests

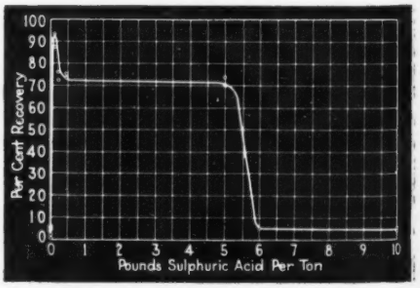
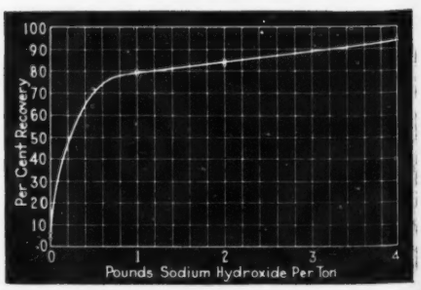


Fig. 2—SODIUM HYDROXIDE additions to the pulp effected the recovery of the placer gold in the manner shown in the graph below



quantities of sulphuric acid (0.05 and 0.025 lb. per ton) were used (Tests 15 and 16). However, when sufficient acid was added to change the pH to 7.7 or alkali to change the pH to 8.2, a marked increase was obtained (Tests 13, 14, and 19). In the previous series of tests, without the use of any pH modifiers, a recovery of over 80 per cent was attained (Tests 5 and 6, Table I). These results suggest that some foreign matter had formed a coating on the gold and thus impaired its floatability, and that the addition of either sulphuric acid or sodium hydroxide removed this coating.

Further weight is lent to that hypothesis by the results of Test 18: The ore was first agitated for ten minutes in the cell with 0.10 lb. of sulphuric acid per ton. The pulp was then filtered and thoroughly washed with water to remove the acid. This washed material was then put back into the cell with xanthate and terpineol, conditioned, and then floated. The recovery increased sixteen-fold. This can be taken to indicate that the surface of the gold in this material was cleaned by pre-treatment with acid.

As the pH was lowered below 7.7, by the addition of sulphuric acid, the recovery decreased until at pH 3 only 5 per cent of the gold floated. As far as the pH range was investigated, the maximum recovery was obtained at pH 10.4. This was obtained with 4 lb. of sodium hydroxide per ton. Figs. 1 and 2 are graphs plotted from the results.

These results, though only a start on this problem, indicate that a new method should be developed, by which more accurate results can be obtained. Each test should be run in duplicate, or, better still, in triplicate, in a large cell, possibly one having a capacity of 2,000 grams, to minimize the errors inherent to gold ores containing free gold—spotty ores. The weight of concentrate obtained from such tests would be small, due to the high ratio of concentration usually obtained with this type of ore, and consequently the total concentrate should be assayed to avoid sampling errors on such high-grade material.

Obtaining the metal content of the tailings would be somewhat more difficult, due to the large quantity of material, but satisfactory results could possibly be obtained by grinding all the tailings to minus 100 or 150 mesh in a laboratory pulverizer, retaining separately the "metallics" if any. The pulverizer, preferably, should be used only for this purpose, in order to minimize salting errors. By employing this method for the testing of free gold ores, the results should be much more exact and more definite conclusions could be obtained.

Delivering Ore in Chutes

An otherwise simple problem may at times be complicated by circumstances

W. E. Sinclair

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South Africa

DELIVERING ORE from a higher to a lower elevation is one of the easy problems confronting the engineer in the important operation of handling rock. There are certain circumstances, however, when such factors as inclination and length of slope, points of loading and discharge, and the nature of the rock being handled require special consideration, thus making a problem of what is normally a simple operation.

In the example shown, the cost of handling and the available capacity of the layout were factors of paramount importance, as is usually the case when producing a low-priced commodity, in this operation limestone. It was being mined by hand from cave deposits near the top of a steeply sloping hill about 300 ft. above the point of delivery.

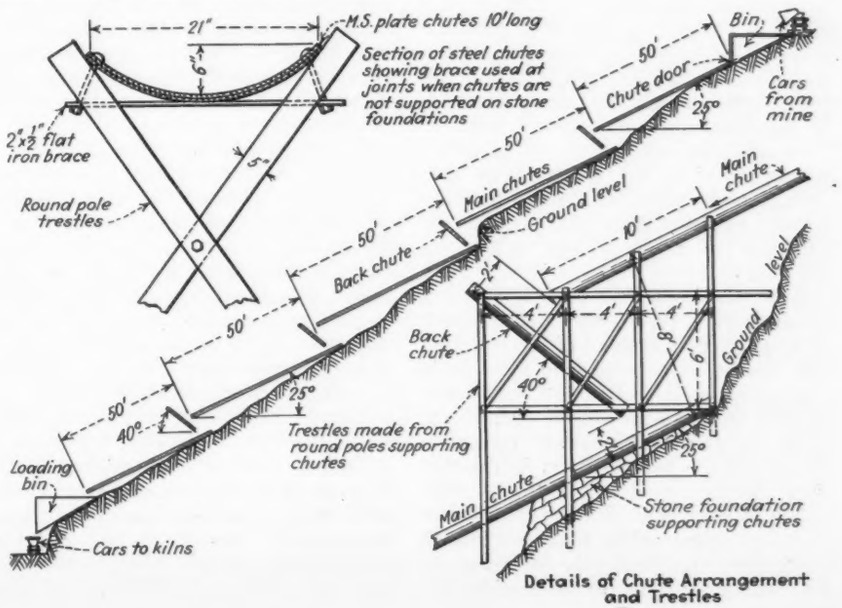
Before describing the equipment used to deliver the stone to the cars, I should mention that approximate sizing and selection of the stone to 4-in. and 5-in. chips suitable for calcination in kilns was carried out as far as possible during mining. Undersize stone (minus 3 in.), being unsuitable for burning in the pot kilns, was, from a point of view of its conversion to lime, a dead loss, so that every precaution had to be taken, even in handling the stone, to prevent unnecessary breakage, pounding, or crushing. As the limestone was a high-grade, crystalline calcium carbonate that was extremely brittle, the usual loss in breakage when delivering the stone was overcome by adopting a method of chute equipment shown in the sketch.

Stone was delivered to the chutes from a central discharge bin, all of it being loaded to this bin by side-tipping cars from various working places. Loading of cars was carried out by means of ballast forks, which obviated the inclusion of undersize material in the stone deliveries. The feed from bin to chutes was controlled by the usual type of sliding door, manipulated by one man.

Arrangement of chutes is shown in detail in the sketch, the angle of inclination of the main section and back chutes being the most suitable for the material being handled, but possibly not ideal for every class of ore or for varying sizes. From experiments carried out, it seems that for a heavier kind of stone or for handling larger pieces, a general flattening of the inclination would be necessary.

The chutes are made from 10x2 ft. quarter-inch M.S. plate rolled to suitable radius.

Cost of chute and material averaged 4s. per running foot, and the cost of erection averaged 1s. 9d. per foot, a total of less than a third of the cost of a balanced trackway or any such method of working.



Details of Chute Arrangement and Trestles

Weighing New Offerings of

- AN INQUIRY as to criteria that will protect the intelligent layman whose money is needed if prospects are to be developed into new producers

- HIS RISK should be confined to that inherent in mining . . . Eliminate that due to dishonesty, unskilled management, or an unfair financial set-up . . . A vital concern of the engineering profession

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WITH the passage of the Securities Act of 1933 and the amendments to it contained in the Securities Exchange Act of 1934 the means appear available for cleaning up some of the tarnished spots on our methods of raising capital for industry. This possibility should be of special interest to miners because, in both the past and the present, mining's fraudulent fringe has been accused, with considerable justice, of perpetrating some of the most outstanding attempts to mine wealth from the deposits and pocketbooks of the unwary speculator. Even with the help of the Securities Act the clean-up can only come if the efforts of the Commission are given hearty support by the mining profession. To date the Commission by its evident attempt "not to stop anything until it knows how to start it again" and the reasonableness of its demands seems to justify the sympathetic assistance of our whole profession in the effort to disperse the black cloud that has made the phrase "investing in gold mining stocks" the last word in foolish speculation. All of us have been galled by this condition, knowing as we do how essential investment in mines is to our civilization based on the use of metals and how desirable a speculation a properly conceived and managed mining enterprise may be.

Risk and Reward

The development of mines is of necessity a highly speculative undertaking and no possible way of reducing the physical hazards by the passage of any law can be devised. On the other hand, the reward attainable by a successful development is as great as the hazard. It is this large potential reward acquired by a small expenditure of capital at the proper point in the earth's crust that generates the poorly organized and dishonest ventures that make legitimate attempts to raise mining capital so difficult.

The lure is painted so brightly that those of small means are attracted to it as to a lottery and those of larger financial ability, even those who have made real successes in their own fields, are so blinded as to lay themselves open to the hook of the unscrupulous promoter. Much will be accomplished if the Act does nothing more than to dim the colors of the writer of prospectuses who in the past, untroubled by either fact or probability, has been able to utilize all the technic of high pressure salesmanship; to dim them so that the man who does try to stick to the facts is not put wholly in the shade. The SEC by insisting that the dark spots in the picture should not be masked out entirely can warn the wise and perhaps scare off the ignorant.

At the outset, the Commission should draw a sharp distinction between the legitimate and useful effort to make a mining profit by turning a prospect into a producing mine, and that other field of endeavor, masking under the name of mining, in which a hole in the ground or even at times a real orebody is used as a means to plunder the greedy or necessitous of funds, little or none of which ever leave the pocket of the promoter to reach the so-called mine. Anything that reduces the take of this second group will obviously further the success of the first both by conserving the speculative capital and by avoiding the stigma cast on mining investments.

Three factors determine the success or failure of the ordinary new business adventure. They are in order: the competitive conditions and possible chance in the field to be entered; the energy, efficiency and good intent of the management; and the financial set-up of the enterprise in relation to the capital demands of the business and the proportion of profit going to the different classes of investors, and to the organizers. In the case of a mining enterprise, however, more than the above is required. You may be seeking to produce a non-competitive product like gold with a legally fixed price; your management may be better in every respect than any ever before assembled; the financial set-up may afford unlimited capital at a low rate of interest so that all the profit will go to the adventurer without any rake-offs and yet, if the adventurer forces his staff to expend any money, it will all be lost if there is not available a body of mineral of such size and richness that it can be made into a mine. This vital position of the orebody in any mining operation makes it necessary that all obtainable information about it should be furnished and that no attempt should be made to obscure the absence of such information by words. The honesty and experience of the promoting group can usually be correctly judged by the way this question of ore supply is handled in both literature and conversation. The ignorant and inexperienced and above all the deceitful will tell his readers so much about the neighboring orebodies and the bonanzas of the past that the layman will quite overlook how sparse is the reference and how untrustworthy the specimen assays supplied in regard to the deposit on which the whole success of the enterprise must rest.

The Prospect Needs the Layman

Granting then that full data on the ore occurrence must be given if the public is to be protected, the thought will at once arise that if we know all about the orebody and what we know is all favorable, we would not need to make a public stock offering, because informed, existing corporations would take over the deposit. It is unquestionably true that such capital is available in large amounts to such enterprises as can justify its entrance. When this is sought, however, by a prospect in its early

Mining Securities

stages usually the search is fruitless. On one side of the negotiation is frequently a suspicious and over-optimistic claim owner, on the other a cold-blooded, hard-bitten investigator who feels himself in a fiduciary relationship to his principal; the result is that, even if the enterprise is investigated to the point of consideration of terms, capital often will demand so large a proportion of any possible profit that the original discoverer or his honest and legitimate successor is offered little reward for his labor and risk and little incentive to find another prospect. Although I am far from condemning this necessary attitude of the managers of large capital and am equally far from condoning the all too common excessive demands of the discoverer and first promoter, yet I do feel that a little personal interest and a certain amount of warm-blooded, sympathetic optimism is required through the prenatal and infantile periods of a mining enterprise. I do not mean the blind optimism of ignorance or cupidity but such as that, for example, which actuated Harry Oakes in the early stages of the Lake Shore mine. Without this optimism the exhaustion of existing mines will soon rapidly exceed the development of new ones. To force the simile, what is needed is eugenics and birth control, not sterility or abortion.

Protection for Uninformed Investor

The public as individuals must therefore take a large share in the development of mines. The chance for large gains and the bliss of ignorance would make it almost impossible to keep the layman out even if it was desirable. Since mining needs him, it owes it to itself and to him to provide every possible protection. The most the mining industry can do is to confine so far as possible the risk of the uninformed investor to the mining risk only. This risk is great enough without adding to it the risk of a dishonest or unskilled management or of a financial arrangement that would rob him of a just share of the profit if any is made. In carrying out this object the Securities Act, properly administered, is the most potent weapon that has yet been made available. One cannot by laws protect a fool against himself, but the Act, if it is supported, should enforce the disclosure of the known facts about a property in such a way that the well-informed can fairly estimate the risk involved and, by setting against it the possible profit, determine for themselves the speculative value of the enterprise and so advise others.

In addition to the importance of the Act in its control of the supplying of capital for new enterprises, those administering it will of course supervise the issuing of new securities by operating mines. Here will probably be less unanimity on the part of the mining profession. Knowledge of operating costs, the size of ore reserves, and the changes in both have often in the past been considered as perquisites of the operating staff and the board of directors. It has been claimed, at times with justice, that the small stockholder would be unable to properly interpret such figures and their publication might be used either to scare him out of a desirable holding or cause overinvestment. Uninformed people may draw erroneous conclusions from such figures and may make inter-mine comparisons that would appear ridiculous to those informed as to conditions at the mines compared. Market manipulators have sometimes used these figures to the disadvantage of the stockholder, actual or potential. It would seem, however, that the damage done to the skilled or well advised investor by the withholding of these data would exceed the possible effect of its disclosure on the ignorant. After all, it is a sudden change in reserves or costs that, when disclosed, might cause undue optimism or pessimism. If this sudden change be due to a difference in managerial policy it can be readily explained. If the change be due to a failure of the management, its publication will permit the stockholder to take prompt steps to protect himself. If the changes be due to alteration in the character of the orebody surely the stockholder is entitled to full information as soon as the fact of the change is established.

Essentials in a Report

Without attempting to exhaust the subject, I suggest the ten items below as being among those that should be included or considered in every mining report or prospectus in addition to those required of the ordinary business venture.

*1. A history of the operation with dates, including the financing attempted, the money raised, the work done on the property and its cost.

2. A statement of the tonnage and grade of ore reserves and how this was estimated. If this is not included, its absence should be noted and explained. Lacking a statement of actual reserves, complete mention should be made of the length, width, and value of the ore encountered on each level, stating the way in which these figures were obtained. If in turn this latter statement is not included, the reason should be given and a sentence added admitting that the absence of such data makes any figures used in the prospectus as to future outputs or profits mere speculative guesses.

3. If profit figures are given, there should be an estimate of the costs and information as to how they were obtained.

*4. Any reports or statements from reports of geologists or mining engineers which are used should carry the date (year) of the report and where the complete report is deposited. If no such reports are mentioned, a statement should be made explaining their absence.

5. Whenever the balance sheet valuation of the property is in excess of the amount originally paid plus the money actually spent on its development and equipment less depreciation, depletion, and similar items, the basis for this enlarged valuation should be shown in detail.

6. Whenever other properties in the district are mentioned the following data should always be included: A. The distance intervening between the two properties. B. Whether the trend of the deposits of the successful neighbor is toward or at an angle to the direction to the prospect. C. Whether the terrain of the prospect is geologically similar to that of the neighbor mentioned. D. What the mineral character, value, and operating status is of any acreage that intervenes between the two properties.

7. Glowing accounts of the profits won by other mines in the industry should be prohibited as being no indication of the profit predictable from the property being marketed.

*8. When properties in the prospect class are being financed, attempts to raise cash far in excess of that required to explore and develop them should usually be considered an indication of ignorance or dishonesty.

9. The promotional stock should be so restricted that it cannot be sold unless and until the property has made a profit.

10. When the report or the employment of an engineer or geologist is mentioned, enough data should be included so that his former experience can be learned.

I realize that some of the above items may be debatable and offer them purely as a basis for discussion with the hope that agreement can be reached and some accepted list of criteria made available to the public, the engineering profession and to the Securities and Exchange Commission.

*Those items so marked apply primarily to new enterprises or revivals of abandoned mines.

GOLD IN SURINAM

4—Natives washing gold gravel in a long tom. Similar operations and others even simpler are multiplied many times in the Colony

SINCE 1742, when the first company was organized to search and mine for gold in Surinam, or Dutch Guiana, the precious metal has figured in the white man's history there. Mining with more modern technique began in 1862, since when an important output has been shipped abroad annually. Today prospecting is active and exploitation of placers and lodes is being vigorously pressed. 1—Milling gold quartz at the Callao mine. 2—Quartz mining at the property

When the Small Operator Figures Costs

A flexible but definite system is recommended wherein a separate account is set up for each and every part of the work

A. L. Russell
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MANY small mine operators are faced with the fact that they do not know if their methods of reducing costs are really lowering them. Others are conducting an enterprise that should pay dividends but does not, and they cannot put their finger on the cause. The solution of these problems lies in a definite and planned schedule of accounting, be it administered by the accountant or the mine manager.

For the benefit of the manager who is just starting an operation and those who find their present system not giving proper results I have prepared an outline of a system that has been tried under actual operating conditions and found entirely feasible for small enterprises. For the sake of brevity, this is presented as an outline, as follows, with running comments on the items included.

CHART OF ACCOUNT CLASSIFICATIONS

FOR SMALL MINE OPERATIONS

ASSETS

ACCOUNT NO. ACCOUNT TITLE

Cash

1. Petty cash fund
2. Cash on hand undeposited
3. Bank operating account
4. Bank special account

All of these accounts are self-explanatory. Account No. 4 can be eliminated, depending on local conditions.

Receivables

5. Notes receivable
6. Deposits placed on purchase orders
7. Subscriptions received on capital stock
8. Accounts receivable on metals in transit
9. Accounts receivable from officers, directors and employees

Under this heading is carried the entire income of the mining property, be it a developing prospect or a full producing mine. Care should be taken to carry item No. 8 at actual amounts to be received. There is no use fooling anyone on this item. Careful and accurate sampling will give the correct answers. Account No. 9 includes board, rent, supplies, and other debts of employees.

Inventories

10. Ore broken in stopes
11. Ore blocked out in mine
12. Ore milled, concentrates
13. Gold bullion
14. Materials and supplies on hand

Item 11 of this heading is the most important. The determination of this amount should be made by a competent engineer. As development work progresses from the point where the original estimate was made, the mine manager can, by careful measurement and sampling, add to this figure as additional ore is blocked out and subtract as ore is mined and milled.

Prepaid Expenses

15. Unexpired insurance
16. Employees' liability insurance deposit
17. Prepaid taxes

Item 16 of this head applies only to companies operating under state compensation plans where advance deposit is required.

Properties

18. Cost of properties (actual)
19. Value of developments (not ore)
20. Value of timber, water power and other natural advantages

Here is one of the most controversial subjects handled by accountants. It is not the aim of this outline to enter into arguments as to how mines should be valued. It is my opinion that the properties should be carried at actual cost. Developments should be carried at their actual value. A road that cuts 50c. a ton off the hauling charges of ore where 10 tons of ore is shipped every day is worth $5 a day for every day it is used. Timber can be estimated by an experienced timber cruiser. Water power is worth just what it actually produces. A site that produces 300 kva. is worth the equivalent purchased from a power company.

Buildings and Equipment

21. Mine and mill buildings
22. Other buildings
23. Machinery and equipment
24. Small tools
25. Trucks and automobiles
26. Construction in progress
27. Office furniture and fixtures
28. Other furniture and fixtures
29. Machinery not in use and for sale

All of these items are carried at their new or replacement value. Item 29 is, of course, carried at its sale price. Depreciation is carried under a separate account and heading.

Other Assets

30. Investments, stocks, and bonds
31. Options, leases, and contracts

Investments are naturally carried at the market value. The value of options, leases and contracts, other than the principal mine contract, must be estimated. Conservatism at this point will impress anyone making an examination of the books of a mine.

Deferred Expenses

32. Incorporation expenses

The company charter, bylaws, seals, and such are an asset and should be carried as such at actual cost.

Under liabilities the actual expenses of operation and the liabilities of stock issued are found. Note following page.

LIABILITIES

Current

33. Notes payable
34. Accounts payable
35. Dividends payable
36. Freight and treatment charges payable

Item 34 includes not only the supply bills payable but also payroll account.

Accrued Liabilities

37. Accrued taxes
38. Accrued insurance
39. Accrued accounts
40. Accrued miscellaneous

This is included in the outline from necessity, but it is hoped that very few operators will have to use it.

Fixed Liabilities

40. Mortgages payable (interest)
41. Purchase contracts

When a payment on either interest or contract is due it is transferred to current liabilities and credit in the reduction of the amount is given to the fixed liability.

Reserve Accounts

42. Reserve for depreciation
43. Reserve for depletion

Capital Stock

44. Stock issued
45. Stock not issued

Surplus

46. Surplus earned
47. Surplus capital

No comment is needed on these three heads. As the mine manager is using his accounting to determine costs and not financial structure, this will suffice.

◆

EXPENSE ACCOUNTS

Mining Developing Expense

48. Superintendence
49. Engineering, assaying, and sampling
50. Breaking rock (drilling, loading holes, and other miner's work)
51. Explosives
52. Mucking
53. Tramming underground
54. Pumping
55. Sorting and loading
56. Track, pipe, ties, and accessories (including labor)
57. Timbering
58. Tools, illuminants, and sundry
59. Repairs
60. Insurance
61. Compressed air
62. Hoisting waste
63. Hoisting ore

Ore Breaking Expense

64 to 79. These items are the same as developing expense

With the list of items set down in the foregoing it will be possible for the mine manager to arrive at his costs for each operation and the costs per ton of ore mined. These accounts are further divided into labor, power, supplies, replacements, and other pertinent classifications by the use of time cards and requisitions which give an even further check on the operation. By comparison with previous experience and by keeping track of what is going on in the mining industry, which can be done only by reading the technical journals, the mine manager should be able to see just where his operation stands.

A certain amount of estimating must be done in computing costs for developing and ore breaking. Engineering, superintendence, pumping, compressed air, and insurance must be divided between the two heads and in some cases must be carried on to other heads as in the case of adjacent operations.

Subsidiary accounts are carried for each raise, winze, drift, or crosscut under development expense and similar ones for each stope under ore breaking.

In starting an operation or installing a new accounting system every precaution must be taken to be assured that everyone connected with the system completely understands its operation. For example: It is the duty of the shift boss to see that all time cards are filled out properly and to see that all supplies are charged to the proper account and proper location.

Under Account 53, Raise 14, the trammer makes out his time card showing 50 cars trammed to pocket in 8 hr. at $3.50. A requisition made out by the trammer shows one pint of oil used for the car. A combination of a time card and a requisition shows that the blacksmith spent 1 hr. and 5 lb. of coal on repairs to mine car No. 89, which is the one used by our trammer, or the sum of $0.90. The total of all these gives $4.49, the tramming costs, which equals $0.1125 per ton trammed. All other accounts are figured in the same manner.

Milling Expense

80. Primary crusher
81. Conveyor No. 1
82. Secondary crusher
83. Conveyor No. 2
84. Primary ball mill
85. Amalgamator
86. Primary classifier
87. Tabling
88. Pumping sands
89. Thickener No. 1
90. Secondary ball mill
91. Secondary classifier
92. Flotation
93. Pumping concentrates
94. Thickener No. 2
95. Filtering
96. Pilot tabling
97. Sampling and assaying
98. Water
99. Water reclamation
100. Tailings
101. Loading concentrates
102. Repairs
103. Insurance
104. Lighting
105. Supplies
106. Heat
107. Superintendence
108. Labor

By examining the schedule so far outlined the conclusion is at once reached that I recommend the carrying of each operation as a separate account. This may seem at first as a very involved process, but after the system is given a fair trial the user will recommend it as one that positively gives "finger-tip" control to the operation.

Accounts 80 to 97 are self-explanatory. No. 98 covers the obtaining of water for the mill, whether from outside sources or from the mine. Expenses should be split between the mine and mill where this is the case. Labor is carried as a separate item in the mill accounting, because of the confusion that would result from figuring two or three men's wages on twenty or more different operations. These accounts are also subdivided as to power, supplies, repairs, and such.

Depreciation Expense

109. Buildings
110. Underground equipment
111. Surface equipment at shaft
112. Mill and conveyor equipment
113. Transportation equipment
114. Miscellaneous equipment

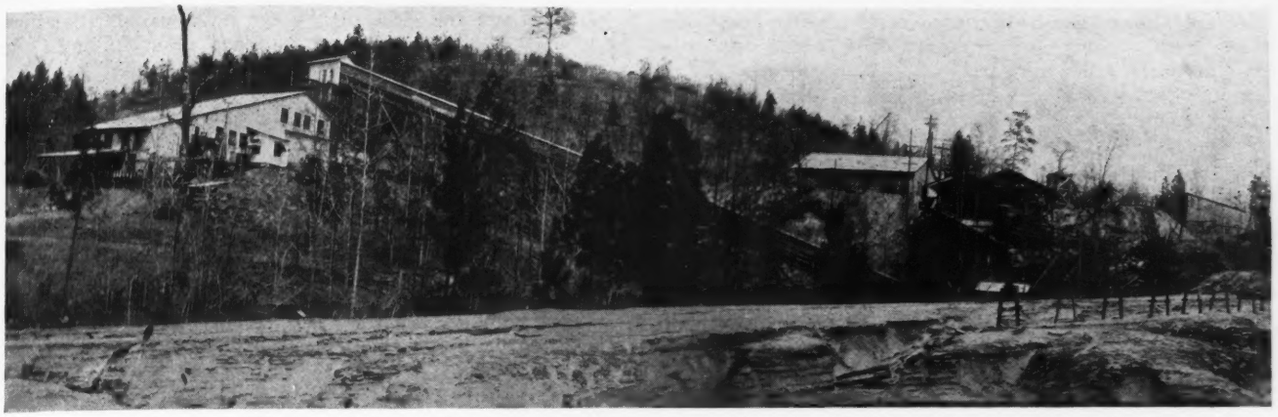
Inasmuch as any depreciation is more or less a guess because the true rate of depreciation can be determined only after a machine is worn out and thrown away, experience and care are needed in this phase of the work. Certain standard practices can be applied, such as writing trucks and cars off in five years, but in the case of an operator who has purchased second-hand equipment common sense and experience must be his guide.

Overhead Expense

115. Administrative salaries
116. General Office salaries
117. Legal and auditing
118. Office expense
119. Traveling expense
120. Boarding house expense
121. Tenement expense
122. Miscellaneous expense

One phase of this schedule that should appeal to the small operator is its flexibility. Though it is planned for a mine and mill with concentration, amalgamation, and flotation, with two-stage crushing and series grinding, it can just as readily be adapted to a simple stamp mill with only amalgamation. Under milling expense a smaller number of accounts is used, but each operation is carried as a separate account. Crushing would be one account; stamping, another; amalgamation, another; tabling or jigging, another; and so forth down the list of each operation.

Standard printed forms which can be purchased from a supply house are used. The advantage of this system is that it is foolproof. If the men handling it are properly instructed upon its installation, it will give a positive check on costs with a very small expense.



FLOTATION PLANT of 150 tons' capacity and other surface buildings of Hog Mountain Gold Mining & Milling Company, 12½ miles from Alexander City, Alabama. The ridge from which the enterprise takes its name rises from the Ashland Plateau

Southern Gold At Hog Mountain

Progress in mining and milling with standard methods at the leading enterprise in the Appalachians . . . Improvements planned in flowsheet to increase recovery and cut tailings loss

N. O. Johnson

Mill Superintendent
Hog Mountain Gold Mining & Milling Company, Alexander City, Ala.

GOLD MINING first began at Hog Mountain, in Alabama, in 1844. In that year and the one following ore was mined at the south end of the mountain, with crude appliances, and a small amount of gold was recovered with a ten-stamp mill and amalgamation plates. The property then remained idle until 1893, when H. T. Aldrich obtained control and built a 75-ton cyanide plant, in which a total of between $250,000 and $350,000 was produced in the 23 years following. During this period numerous veins were developed on the northern half of the mountain and mining was carried down to the sulphide zone. Work was finally abandoned in 1916, owing to higher labor and material costs during the War and the depletion of the more amenable oxidized ores.

In 1931 serious exploration was begun by the Hog Mountain Gold Mining & Milling Company, under E. H. Emerson. Up to the present underground work has consisted of drifting and stoping along the two principal veins and a small amount of development work along other veins. A 150-ton flotation mill, together with an office, shop, and a camp, has been erected. To obtain the necessary power a 12.6 mile 44,000-volt transmission line was erected, connecting with the Alabama Power Company station at Alexander City, where the company has its headquarters.

Hog Mountain lies within the boundaries of the Ashland Plateau. It forms a conspicuous ridge rising 300 or 400 ft. above the surrounding country and reaching a height of more than 1,000 ft. above sea level. The topography is typical of the gently rolling, deeply eroded southern Appalachian region. Hillabee Creek, a branch of the Tallapoosa River, constitutes the largest part of a good drainage system.

The climate is mild and humid. The mean annual rainfall is approximately 55 in., being well distributed throughout the year. Vegetation typical of the region includes hickory, oak, and long- and short-leaf pine. Most of the trees are of second growth, but a few regions of uncut timber remain. A thick undergrowth covers most of the countryside.

The Wedowee formation and the intrusive quartz-diorite, considered to be an offshoot of the much larger areas of Pickneyville granite to the west, have been distinguished at Hog Mountain, according to C. F. Park, Jr.[1] The former consists of fine-grained graphite schists. These are, in part at least, of sedimentary origin, and in places partly recrystallized, containing mostly quartz, amorphous graphite, and fine-grained sericite. Bedding planes in the schists are almost obliterated, but where present are cut by the schistosity at an angle. The schist planes are intricately folded and faulted, but generally strike northeast 10 or 20 deg. and dip east steeply. The age of the formation has not been definitely established.

Further, according to Mr. Park, the intrusive quartz-diorite is a light gray in color with an even granitoid texture. In this formation occur the auriferous veins. It covers an area of more than 4,500 ft. in length and about 1,000 ft. wide. The strike of its long axis is roughly parallel to the schistosity of the surrounding schists. Most of the veins strike between N. 60 deg. E. and due east-west, with dips of 50 to 85 deg. to the north. In a few places where followed toward the schist and quartz-diorite contact, the veins widen, forming pipe-shaped orebodies, but commonly they split into many stringers and pinch out at the contact. Shear zones, conspicuously developed in the quartz-diorite, are less noticeable in the

[1]A.I.M.E. T.P. 598.

schists. They strike almost due east and dip north. Many of the shear planes cross the veins, though some bend and merge with the veins. Certain shear zones, though carrying less gold than the vein material proper, are still high enough in value to be economically mined and milled.

Erosion has been considerable and much ore must have been lost, as the deposits are of the deep-vein type, and must have extended up into the eroded portion, resulting in the loss of a large quantity of gold. Had the gold been coarse, this erosion would have resulted in placers of real importance.

Former operators report that the ore was slightly richer at the gradation between the oxide and sulphide zones. Some concentration of value has been found near open cuts by the present operators. As there is, however, small difference between the assays of the present assay workings and the reported assays from the old workings in the oxidized ore, it is evident that supergene enrichment has been of small importance.

Gold With Sulphides

Quartz is the most abundant vein material. Below the water level it is generally massive, vitreous, dark or bluish-gray where associated with gold, and usually light gray or white where barren. The gold values seem to be associated with the sulphides. Pyrrohotite is the most abundant, and chalcopyrite, arsenopyrite, sphalerite, and pyrite occur, but usually in small amounts. The gold is all finely divided and is intimately mixed with or inclosed in the sulphides. Free gold can easily be distinguished in the flotation concentrates under the microscope, and it is possible, but extremely difficult, to obtain very fine colors by panning. Silver is present, but to the extent of hardly more than a trace. The flotation concentrate carries about 0.4 oz. of silver to the ton.

Prospecting and exploration are done by drifting and raising. Prospect headings are frequently run from the stopes. As the ore cannot be projected too far ahead of actual exposure, exploration workings follow it as closely as possible.

Much sampling is done, both in exploration workings and in stoping, to control the grade of the material delivered to the ore bin. All muck piles in the face are sampled after each round. The results of these samples determine whether it is sent to the ore bin or to the waste dump.

Longitudinal maps are drawn of all stopes, and from them estimates of the broken ore reserves are made. The grade of these reserves is estimated from grab samples taken in stoping, and checked by grab sampling all cars drawn from each stope.

Of the four stopes completed, the average width is 6.75 ft. and the length 116 ft. Data pertaining to these stopes are given in Table I.

The West Blue vein stope and the Barren vein stope were worked prior to the present company's operations. Assays for these stopes are based on the average of all the cars that have been removed from the respective stopes. All the low-grade ore from development work has been sent to the mill, which has tended to lower the heads.

Opened by a 215-Ft. Shaft

The mine is worked through a two-compartment shaft 215 ft. deep located 200 ft. east of the west contact of the quartz-diorite plug and very close to the north end. At 160 ft. below the collar, the west contact is cut, the formation dipping less than 45 deg. at this particular point.

Each compartment is 4½x6 ft. in the clear, and timbered with 8x8-in. sets at 5-ft. centers. One compartment is used for the cage and the other for air and water lines, electric cables for lighting stations and for signals, and also as a ladderway.

Stations are cut 10 ft. high by 15 ft. wide at the shaft and tapering to drift size in 20 to 30 ft. Stations are cut on both sides of the shaft.

All drifts and crosscuts are 5x7 ft. in size and nearly all are untimbered. Drilling is done with Ingersoll-Rand S70 drifters mounted on vertical columns, using 1¼-in. hollow round steel. Standard crossbits with double taper, gage changes of ⅛ in. and length changes of 12 in. are used. A round consists of 13 to 16 holes, depending on the nature of the ground. Best results are obtained with 60 per cent gelatine dynamite and an average 4 ft. advance per shift can be maintained in each heading.

All mucking is done by hand into 16- and 20-cu.ft. box-type, end-dump cars.

Raises are driven as needed for the shrinkage-stope draw points and for ventilation. A considerable amount of prospect work is also done by raising. A round in the raises is drilled by one miner and a helper, using a self-rotating Sullivan S-2 wet stoper and 1-in. hollow hexagon steel.

Shrinkage Stoping Used

The distribution of the values within the orebody is erratic; small and large granite horses of waste are encountered and the trend of the ore is so irregular that no stope layout can be designed ahead of the stoping. Stoping limits are determined by the width and the assay.

To estimate accurately the grade of the ore by eye is impossible; therefore sampling is relied upon to guide the stoping. Experienced men, however, can distinguish barren or low-grade vein material from that which contains values.

Shrinkage stoping is used because of the excellent walls and the fair widths of stopes.

Drilling in the stopes is done with the same machines and steel as are employed in the raises. Holes are drilled 4 to 8 ft. deep and 2 to 4 ft. apart. However, where the values go into the wall of the stopes, as is true in zones of shearing, slabbing rounds with a drifter are occasionally necessary. Blasting is done with 60 per cent Hercules dynamite and electric delay caps when a large number of holes are to be fired. Usually, the whole back is drilled and then fired at the same time. This practice keeps the amount of fumes in the stope at a minimum. Wherever possible, the work is done on contract. In drifting, the men are paid per foot of advance, and in the stopes per foot of hole drilled.

In places where the ore will not run by gravity, muckers are used in the stopes to shovel it. A scraper operated by compressed air has been used to advantage in cleaning the footwall of stopes where the dip is around 55 deg.

Manways into the stopes have a single compartment with 3-in. cribbing along stulls set about 5 ft. apart. Chutes are built of timber 15 to 20 ft. apart. Usually, rock pillars are left over the drift between chutes, but in some instances the broken ore is carried on stulls over the drift. An effort is made to reduce all the boulders in the stopes to 12 in. or smaller before being drawn into the muck. In spite of this precaution, some must be blasted in the chutes.

Tramming by Hand

All tramming from the stopes is done by hand. The average distance from the stopes to the stations is about 250 ft. Switches are placed at each station, which reduces any time loss when the cage returns with an empty car. The loaded cars are hoisted from the 100- and 200-ft. levels to the surface, where an empty car is waiting on a switch to replace the loaded car taken off. The total time elapsed between the completion of the loading of the cage and its return with an empty car is 2½ min. to the 200-ft. level. Two surface trammers tend to the charging of the cars on the cage and tram the loaded cars to the bin at the head of the jaw crusher, which is 75 ft. from the shaft.

A single-drum steam hoist which has been converted to electric power is driven by an Allis-Chalmers 50-hp., 220-volt induction motor through double-reduction hoist gears.

In and near the shaft the workings are ventilated by natural ventilation, which has been made possible by the connection of two stopes with the sur-

Table I—Data of Completed Stopes

Stope	Average Length, Ft.	Average Width, Ft.	Average Assay, Oz.	Tons Drawn
West Blue vein 100-ft. level	90.0	4.5	0.190	2,916.3
Shear zone 100-ft. level	145.0	11.0	0.194	12,181.2
Barren vein 100-ft. level	100.0	3.5	0.304	4,281.5
Blue vein 200 ft. level	130.0	8.0	0.186	9,571.4

face. However, in dead-end workings the ventilation is bad and necessitates the running of the motor-driven fan on the surface. The air is delivered through 12-, 10-, and 8-in. galvanized pipes.

The workings are virtually dry. A sump 15 ft. deep acts as a reservoir for all the shaft drainage. It is pumped out once a day by an Cameron centrifugal pump direct-connected to a 15-hp. motor driven at 1,750 r.p.m. It handles 150 g.p.m. and empties the sump in approximately two hours.

Compressed air is supplied by two compressors, a Chicago-Pneumatic and a Sullivan. The former is a duplex, two-stage unit, 17x10x12-in., and is driven through a 14-in. endless belt by a 150-hp., 2,200-volt, General Electric induction motor; the Sullivan is of the angle-compound type, 17-9¾x12-in. in size, and is driven through a 14-in. endless belt by a 150-hp., 2,200-volt, General Electric induction motor. The combined capacity of the two machines is approximately 1,500 cu.ft. of air per minute.

The blacksmith shop has one Ingersoll-Rand Type 50 sharpener and one Denver Rock Drill Model 8 sharpener. Other equipment is an oil furnace, an Ingersoll-Rand compressed-air-driven emery wheel, and a forge. Two shifts handle about 500 pieces of steel daily, in addition to making new steel and doing other necessary blacksmith work. A complete machine and carpenter shop aids substantially in construction and repair work in the property.

Electric power is delivered to the mine substation, where six 75-kva., 44,000-2,300-volt transformers are located. Large motors operate on 2,200 volts; the remainder of the power is taken at 220 and 110 volts from three additional 75-kva., 2,300-200-100-volt transformers. The total connected horsepower on the property is 877½, with a kilowatt demand of 359.2. Power consumption is between 150,000 and 200,000 kw.-hr. monthly.

Water for all purposes is delivered to a 16,000-gal. tank near the mill. A Worthington centrifugal pump, operating at 3,500 r.p.m. and driven by a 40-hp. motor, pumps the water through a 5,300-ft., 4-in., cast-iron pipe against a 300-ft. vertical head.

Mining Cost, $1.82 per Ton

Average costs of mining 7,754 tons during the months of October and November, 1934, are given in Table II.

Milling operations were started at the property in 1893, at which time a cyanide plant was treating coarsely ground (minus-¼-in. mesh) oxidized gold ores. After approximately 100,000 tons of this ore had been milled, there remained a very small ore reserve economically amenable to treatment. Experiments were started on the not so limited supply of sulphide ores. However, because of the war prices and the scarcity of labor prevailing at that time, and the unfavorable experimental results obtained from the sulphides, the mine and the mill were closed in 1916. The property remained idle until 1933, at which time extensive sampling and metallurgical tests were made on the sulphide ores. Some of these tests were conducted locally and others by the American Cyanamid Company, and after a complete study of the ore to be dealt with, it was finally decided to use straight flotation, with the possibility of cyaniding the concentrates after the mill tonnage had been sufficiently increased.

Hog Mountain ore consists of quartz containing mostly pyrrhotite and pyrite with small amounts of chalcopyrite. The quartz-diorite wall rock in zones of shearing has small stringers of the same minerals, and such places are taken as ore. The gold is associated with the sulphides. Average gold content of 28,210 tons milled in the last fifteen months was 0.188 oz. per ton. This average head assay includes development ore without which the heads would be more nearly in line with stope averages. During this period the mill flowsheet was changed by the addition of a jaw crusher and a flotation cell. The general process consists of taking the ore coming directly from the mine cars and crushing it to 4 in. in a jaw crusher. Then the ore, after passing over a picking belt, is crushed in a gyratory crusher and delivered to an 8x6-ft. ball

IN THE BLUE VEIN stope (above), on the 200-ft. level. The photograph shows the width of vein and its well-defined walls. This stope averages 130 ft. long and 8 ft. wide, and assays 0.186 oz. of gold per ton. From it, so far, almost 10,000 tons has been drawn

IN THE SHRINKAGE STOPE (at left) on the Barren vein, on the 100-ft. level at Hog Mountain. Here may be seen to best advantage the width of the vein and its strong, well-defined walls. This stope averages 100 ft. in length and 3.5 ft. in width, and assays 0.304 oz. of gold per ton. It has yielded thus far over 4,000 tons of ore

Table II—Average Mining Costs, October-November, 1934

	Per Ton	
Drilling and blasting		$1.327
Labor	$0.464	
Explosives	0.200	
Machine drills (drill sharpening, compressed air, steel consumption, and repairs)	0.663	
Total	$1.327	
Tramming and mucking		0.1933
Timbering		0.0556
Hoisting and dumping		0.1011
Assaying and sampling		0.0119
Miscellaneous		0.1316
Total		$1.8205

mill operated in closed circuit with a Dorr classifier. Classifier overflow is floated, giving a 3-oz. concentrate, and the middling is returned to the mill for regrinding. The concentrates are thickened, filtered and dried, and then packed in drums for shipping. Tailings after passing over a pilot table are disposed of as waste.

Average milling costs for October and November, 1934, during which time 7,754 tons was milled, are given in Table III. Details of the various milling operations follow:

Coarse Crushing—Mine-run ore is delivered to a 25-ton hopper, located 75 ft. west of the present 200-ft. shaft. There are double tracks leading from the shaft to this hopper, thus reducing time lost while dumping. The ore from the hopper gravitates into a 18x36-in. Blake-type Traylor jaw crusher. A gate in this chute is operated by the crusher man and prevents any choking of the crusher or overloading of the picking belt. The crusher is driven by a 75-hp., 2,200-volt, slip-ring motor, through a 12-in. belt drive at 230 r.p.m. The discharge opening is set at 4 in., and with a ¾-in. stroke has a capacity of approximately 50 tons per hour.

Picking—From the jaw crusher the ore drops on to the picking belt. This is 24 in. wide and 69 ft. c. to c. and is driven by a 10-hp. motor through a 14.5:1 worm reduction gear. Belt speed is 40 ft. per minute, which gives ample time to the men sorting the granite from the quartz. Sorting along this belt is practiced only when the grade of the mined ore warrants it. The gangue consists of unmineralized granite and quartz. Unless the ore is being drawn from the sheared zone in the mine, all the granite is discarded.

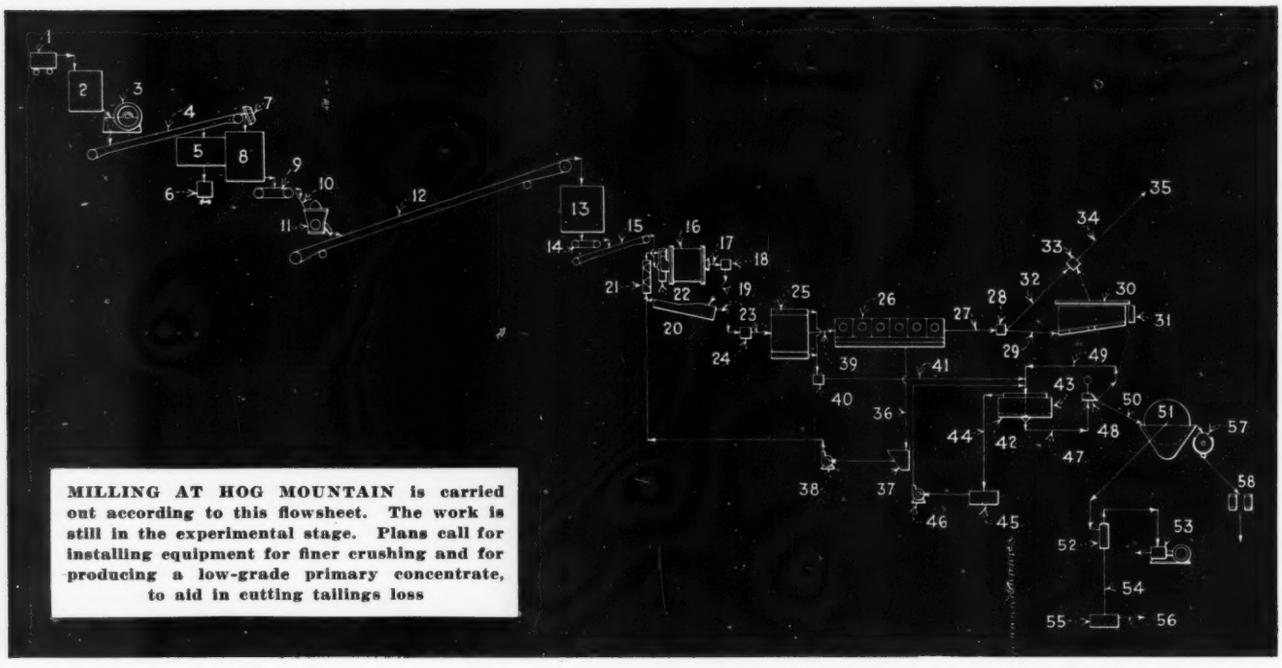
Table III—Milling Costs, October-November, 1934

Coarse crushing and conveying	$0.084
Picking	0.048
	or 0.333/ton picked
Fine crushing and conveying	0.120
Grinding and classifying	0.518
Flotation	0.134
Thickening, filtering, and drying	0.072
Tailing disposal	0.002
Assaying and sampling	0.062
Miscellaneous	0.050
Total	$1.19

All gangue is deposited into chutes under the picking belt, and is collected in a 25-ton hopper, which is emptied by a mine car running beneath it.

A 42-in. electric magnet weighing 1,800 lb. is suspended at the discharge end of the picking belt, catching any tramp iron that may be overlooked by the crusher man and the pickers. The magnet obtains its direct current from a motor-generator set located under the coarse-ore bin. The generator is direct-connected to a 25-hp., 2,200-volt induction motor, and delivers 15 kw. The ore after passing the magnet drops into a flat-bottomed bin having a capacity of 150 tons.

Fine Crushing—From the 150-ton storage bin the ore is fed through a side chute onto a 30-in. pan feeder traveling 3.5 ft. per minute. It is driven by a 7½-hp. induction motor through a belt drive. The speed of this feeder is controlled by a ratchet and arm and is adjusted so that there is a semi-choke feed on the crusher. Ore from the feeder discharges on to a screen made of ½-in.



MILLING AT HOG MOUNTAIN is carried out according to this flowsheet. The work is still in the experimental stage. Plans call for installing equipment for finer crushing and for producing a low-grade primary concentrate, to aid in cutting tailings loss

LEGEND OF MILL FLOWSHEET

1. One-ton mine car
2. 25-ton hopper
3. 18x36-in. Blake-type jaw crusher
4. 24-in. picking belt
5. 25-ton waste bin
6. Mine car to waste dump
7. 42-in. electromagnet
8. 150-ton coarse-ore bin
9. 30-in. pan feeder
10. Stationary screen, 1-in. opening
11. Gates No. 5N gyratory crusher—¾-in. product
12. 18-in. belt conveyor, 294 ft. c. to c.
13. 400-ton fine-ore bin
14. 24-in. pan feeder
15. 16-in. belt conveyor
16. Kennedy-Van Saun 8x6-ft. ball mill
17. Ball-mill discharge
18. Discharge box with ¼-in. trommel screen
19. Classifier feed
20. Dorr classifier—7x30 ft.
21. 12-in. screw and screw box
22. Scoop box
23. Launder to flotation machine
24. Turn box in launder
25. 44x11-in. Fagergren flotation machine
26. Kraut 6-cell flotation machine
27. Tailings launder
28. Turn box with automatic sampler
29. Split feed for pilot table
30. No. 6 Wilfley concentrating table
31. Table concentrates
32. Split feed from turn box
33. Turn box launder to tailings
34. Tailings launder
35. Tailings pond
36. Middlings launder
37. Middlings sump
38. Middlings sand pump (2-in. Krogh)
39. Tailings launder to flotation machine
40. Concentrate launder turn box
41. Concentrate launder to thickener
42. Thickener
43. Thickener overflow launder
44. Thickener overflow pipe to sump tank
45. Sump tank
46. Sand pump
47. Underflow from thickener
48. Diaphragm pump
49. Launder to thickener from pump
50. Launder to filter from pump
51. 6x6-ft. Oliver filter
52. Vacuum receiver
53. Vacuum pump
54. Barometric leg pipe
55. Barometric leg tank
56. Barometric leg discharge
57. Steam-jacketed dryer
58. Packed concentrates

rods and having a 1-in. opening. Screen oversize goes into a 5N Gates gyratory crusher; the undersize bypasses the crusher, going directly on the No. 2 conveyor. The crusher is set at ¾ in. and is driven at 600 r.p.m. by a 50-hp., 2,200-volt induction motor through a 10-in. belt. The crusher's capacity under its present setting is approximately 30 to 40 tons per hour. Both the liners and mantle for this crusher are of manganese steel and especially designed for finer grinding than the regular liners. The life of these liners is approximately one month, after which time the crusher is dismantled and the worn places are built up with manganese-steel welding rods. This building-up process is accomplished by a Wilson arc-welding machine.

The discharge from this crusher and from the screen drops on an 18-in. Condor belt. This conveyor is 294 ft. c. to c. and inclined 19 deg. from the horizontal. The belt, which discharges the ore directly into the fine-ore bin, is located nearly at right angles to the long axis of the mill. It is driven at 89 ft. per minute through a belt-and-gear drive connected to a 10-hp. motor.

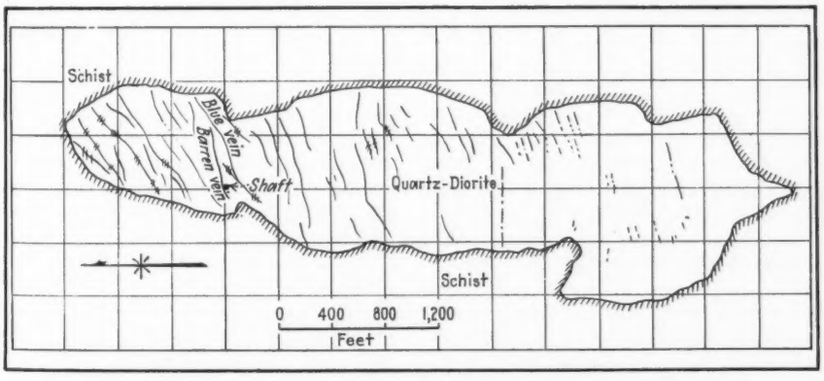
Grinding and Classifying—The fine-ore bin is flat bottomed and has a live-load capacity of 400 tons. The chute delivering from it is located in the center of the bottom, and the ore passes through a steel hopper on to a 24-in. pan feeder, which is driven through a belt-and-gear reduction at 4½ ft. per minute. An adjustable gate on the hopper controls the amount of feed, and the whole feed is shut off by a horizontal rack-and-pinion gate fixed to the bottom of the hopper. The feeder discharge drops on to a 18-in. conveyor belt, which is driven by the same motor as the pan feeder. This belt is inclined 20 deg. and is 11½ ft. c. to c. The ore from this belt discharges directly into the drum of a combination drum-and-scoop feeder attached to the ball-mill trunnion.

All the fine grinding is accomplished in a Kennedy-Van Saun ball mill 8 ft. in diameter by 6 ft. long. The mill is loaded with 22,000 lb. of 3-in. forged-steel balls and is maintained at that weight by adding 650 lb. daily. The shell liners are 2½ in. thick and cast from white iron. They are zincked into place in the mill and have an approximate life of 16,000 tons original feed. The feed into the ball mill consists of the original product from the crushing plant, the circulated middlings, and the classifier sands.

A 7x30-ft. Dorr classifier is operated in closed circuit with the ball mill and is driven by a 10-hp., 220-volt induction motor, through a 8-in. belt drive operating the rakes at 17 strokes per minute on a 2¾-in. slope. The sands discharge into a box containing a 12-in. helical screw conveyor driven through a belt-and-chain drive connected to the classifier cam shaft. Classifier feed and overflow are maintained as close as possible to 65 and 35 per cent solids respectively, this from experience offering the highest percentage of efficient fine grinding, which is most important in obtaining the best possible recovery. Classifier overflow discharges on to a punched screen which collects small wood chips.

Fagergren and Kraut Machines

Flotation—The pulp then gravitates into a 44-in. Fagergren flotation machine. This machine is equipped with a hard-rubber impeller directly connected to a 7½-hp. motor operating at 680 r.p.m. The froth is skimmed off by revolving paddles on each side of the machine driven through a reduction gear and belt by a ½-hp. motor located on a platform above the machine. Tailings from this machine enter a six-cell Kraut flotation machine, and the concentrates gravitate through launders to a 12 ft. diameter Dorr thickener. The impellers of the Kraut machine are driven by 7½-hp. motors through V-belt drives at 775 r.p.m., one motor serving two cells. The froth from this machine is circulated back into the ball mill by a 2-in. Krogh sand pump driven at 1,670 r.p.m. through a belt drive connected to a 10-hp. induction motor. Tailings from the Kraut cells are divided so that approximately 20 tons per 24 hr. are run over a No. 6 Wilfley concentrating pilot table operating at 295 strokes per minute driven through a belt drive connected to a 3-hp. motor.



QUARTZ-DIORITE INTRUSIVE, in outline, at Hog Mountain. This shows the numerous veins occurring on the property. Most of them dip 50 to 85 deg. north. They do not cross the boundary of the enveloping schist. The long axis of the intrusive is roughly parallel to the planes of schistosity of the surrounding rock

The Reagents Used

Flotation reagents used are as follows: Pine oil, 0.10 lb. per ton; cresylic acid, 0.38; fuel oil, 0.03; amyl xanthate, 0.05; sodium Aerofloat, 0.03; and hydrated lime, 0.40.

Lime is added in the chute at the head of the ball mill by a dry reagent feeder, and the xanthates, sodium Aerofloat, and cresylic acid are added to the launder entering the first flotation machine. Pine oil is added to the various cells in the Kraut machine to keep up the froth, and the fuel oil is fed to the middling pump and returned to the ball mill. Of all the reagents used, cresylic acid is the most essential. It acts both as a frother and a collector; without its presence the grade of the concentrates is noticeably lowered. The other reagents are important and are added in various amounts, but to date nothing definite can be said about their specific reaction in the circuit.

Thickening, Filtering, and Drying—Concentrates are dewatered in a wood tank 12 ft. in diameter by 11 ft. deep, equipped with a Dorr thickener mechanism driven at ¼ r.p.m. A 3-in. diaphragm pump operating at fourteen strokes per minute lifts the thickened pulp from the discharge opening of the thickener to an elevation above the tank. The thickener mechanism and the pump are run intermittently. When filtering, the elevated pulp is allowed to flow into the filter. After filtering, which requires from 8 to 12 hr., the rakes in the thickener are raised and the pump and thickener mechanism are shut down. The diaphragm pump and the thickener are driven by the same 5-hp. motor through belt drives.

Overflow from the peripheral launder located in the thickener gravitates through a 2-in. pipe into a 10-ft. wood tank, where further settling takes place. This tank also acts as a floor drain from the filter and the thickener. The amount of concentrates received in it is relatively small, and it is therefore cleaned out only once a month. A 2-in. centrifugal pump direct-connected to a 5-hp. motor pumps the concentrates from this tank, after the water has been siphoned off, back into the thickener tank against a 20-ft. head.

The thickened pulp from the diaphragm pump discharges into a 6x6-ft. Oliver continuous filter. The drum operates at ¼ r.p.m. and the pulp is agitated both by paddles and by compressed

Table IV—Typical Analysis of Mill Feed

Au, oz. per ton	0.220
Fe, per cent	8.28
S, per cent	4.55
As, per cent	0.10
Bi	Nil
Ni	Nil
Insol, per cent	85.60

Table V—Typical Analysis of Concentrates

Au, oz. per ton	2.75
Ag, oz. per ton	0.42
Cu, per cent	0.62
SiO_2, per cent	20.24
Fe, per cent	42.31
S, per cent	28.44
Bi, per cent	0.08
Pb, per cent	0.02
Cl, per cent	0.02
Ni	Nil
Zn	Nil
MnO, per cent	0.05

Table VI—Typical Analysis of Tailings

Au, oz. per ton	0.039
Fe, per cent	4.2
S, per cent	2.5
SiO_2, per cent	88.0
Al, per cent	3.0

Table VII—Typical Analysis of Middlings

Au, oz. per ton	0.377
Ag, oz. per ton	0.150
Cu, per cent	0.37
Fe, per cent	43.68
S, per cent	13.63
SiO_2 per cent	40.5

air through ½-in. pipes. During the time of filtering, 20 in. of vacuum are maintained by a 9½x8 vacuum pump driven by a 10-hp. motor at 270 r.p.m. Unless the filter cloth becomes torn, it will last for six months or more.

The cake from the filter, discharged with 15 to 20 per cent moisture, drops into a J. H. Day steam-jacketed dryer. The screw in this dryer is driven at 5½ r.p.m. from the same line shaft as is the filter. A 10-hp., 220-volt induction motor is connected by belt to this line shaft, which is directly above the filter. The drying of the filter cake is done in batches. Approximately one ton of filter cake is discharged into the dryer per batch, which is its best operating capacity. The boiler is operated at 40 lb. per square inch, which circulates the dry steam through the dryer, in which the moisture is reduced to approximately 5 per cent in an hour. To lower the moisture much below this percentage would cause a dust loss in handling. The boiler for generating the steam has a rated capacity of 50 hp. and is fired by wood. A steam-heating plant is being contemplated for the mill, using this same boiler.

The finished concentrates after being discharged from the dryer are ready for sampling, canning, and weighing. The concentrates are packed in steel cans 16 in. in diameter by 27½ in. high, and when filled weigh around 400 lb. each.

Mill Control—All the water used in the mill and mine is pumped from Brown's branch, a small clear stream a mile from the mill. It is pumped directly through a 4-in. cast-iron pipe to a 16,000-gal. wood tank 120 ft. above the floor of the ball mill. The water except during rainy seasons is very clear and has no bad effect on the flotation circuit.

Densities of the classifier overflow and the ball-mill discharge are checked regularly by the operators. All samples excepting the tailings are taken by hand at ½-hr. intervals. The original feed into the ball mill is weighed by taking definite time samples every half hour. It is sampled for moisture every 8-hr. shift. Approximately 100-lb. samples are taken each shift of the mill heads, and sent to the assay office, where they are split, crushed, and assayed. The concentrates, middlings, and classifier overflow samples are taken by hand by cutting the pulp stream with specially made sample cutters. Each of these samples weighs approximately 10 lb. and all are also taken every shift. The tailing sample is taken by an automatic sampler designed and built on the property. It cuts the pulp stream every 15 min. and gives around a 20-lb. sample per shift. The final concentrates are sampled daily by taking every tenth shovel from the dryer discharge and placing it in a sample pile. After all the concentrates from the previous day have been dried and packed, the large sample pile is quartered down and is used in making up the shipment sample. The weight and the moisture of these concentrates are kept daily along with the rest of the mill records.

Metallurgical Changes Planned

For the past year the mill operations have been intermittent, due to difficulties encountered during the experimental stage. However, with the knowledge gained from the past operations, the following changes are contemplated, which will not only aid recovery but increase the capacity of the mill:

First, finer crushing equipment is to be installed, which will increase the capacity of the present ball mill and classifier as well as help the fine-grinding problem, which is most important in lowering the gold content of the tailing.

Second, owing to the necessity of maintaining a 2.77-oz. concentrate in order to cut down the marketing costs per tons ore milled, the tailing losses have been high. This loss can be reduced with the producing of a low-grade primary concentrate (10:1 ratio of concentration), which will be reground and refloated in a separate ball mill and flotation circuit. This proposed flowsheet will act as a first step toward a cyanide plant to be installed for the further treatment of the concentrates.

This article has been prepared with the help and permission of P. S. Gardner and George M. Brown, president and general superintendent respectively, and with the assistance of other members of the staff.

Table VIII—Typical Screen Analysis

Screen	Ball-Mill Discharge	Classifier Overflow	Classifier Sands	Middlings	Tailings	Concentrates
Plus 14	1.0	....	2.0	.....	.....	....
Plus 20	....	....	3.0	.....	.....	....
Plus 30	....	....	5.0	.....	.....	....
Plus 40	1.0	....	7.0	.....	.....	....
Plus 50	2.5	....	6.0	.....	.....	....
Plus 65	6.5	....	9.0	0.25	.....	....
Plus 80	2.5	5.7	16.0	0.25	2.75	....
Plus 90	1.5	3.6	5.0	0.50	4.00	....
Plus 100	5.0	4.6	5.0	1.00	4.00	....
Plus 150	35.0	15.6	15.0	6.00	16.00	3.5
Plus 200	37.5	18.7	12.0	15.00	20.25	4.5
Minus 200	12.5	51.8	15.0	77.00	53.00	92.0

Table IX—Screen Analysis and Assays of Flotation Tailings

	Screen Mesh	Per Cent Weight	Assay	Cumulative Per Cent	Value at $35 Per Oz
Plus	150	30.0	0.045	30.0	$0.472
Plus	200	17.7	0.030	47.7	0.175
Minus	200	52.3	0.025	100.0	0.468
		100.0	0.0314	100.0	$1.115

Table X—Mill Operating Data

Jan. 1 to June 1, 1935

Tons crushed	5,863.9
Tons waste picked (experimental)	163.0
Tons milled	5,700.9
Tons concentrates	373.7
Ratio of concentration	15.2:1
Feed assay	0.220
Tailing assay	0.039
Concentrate assay	2.70
Mill recovery, per cent	81.8
Operating time, per cent	30.5

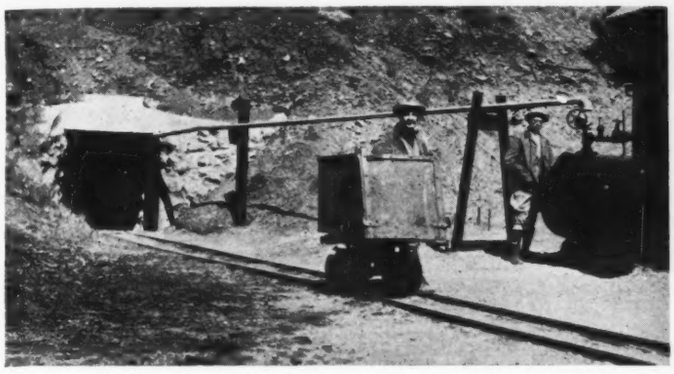
Table XI—Details of Metallurgical Balance

Jan. 1 to June 1, 1935

1,253 oz. delivered to ball mill.			100.0%
141 oz. returned to ball mill.			
1,394 oz. delivered to classifier			
29 oz. recovered in classifier	2.3%		
1,365 oz. delivered to flotation			
997 oz. to thickener	79.5%		
4 oz. recovered in middling pond	0.3%		
1,030 oz. Total calculated recovery	82.1%	82.1%	
223 oz. Total tailing loss		17.9%	
1,243 oz.			100.0%
1,026 oz. Total actual recovery		81.8%	
4 oz. Impounded in middling pond		0.3%	
233 oz. Total tailing loss		17.9%	
1,253 oz.			100.0%

Experimenting in the Mine

AT THE EXPERIMENTAL MINE, at Idaho Springs. Besides the office, here shown, the Colorado School of Mines has also erected a blacksmith shop and a compressor and machinery house



PORTAL OF MIAMI TUNNEL, one of the three entrances to the Edgar mine, now used for underground experimental work by the Colorado School of Mines

A DRILLING TEST being made underground by students in the experimental mine. The property is open also to commercial companies that have underground problems to solve

Old Edgar Property, at Idaho Springs, Now Used by Colorado School of Mines For Purposes of Underground Research

J. Burns Read
Colorado School of Mines
Golden, Colo.

THE MINER'S NET is the metallurgist's gross. The cost of treating the metallurgist's gross is charged to the miner's net. When these two obvious propositions are considered in relation to each other, certain economic factors arise. These factors must be thoroughly considered if the cost per ton of ore mined and concentrated is to be reduced to the minimum.

Let us assume that a given orebody contains 100,000 tons and that the mine recovery is 90 per cent, the same as the mill recovery. In extracting the ore 10,000 tons is lost. The mill then receives 90,000 tons, losing 9,000 in the concentrating process. Let us further assume that the cost per ton of ore mined could have been reduced 5c., and that the cost per ton of ore treated in the mill could have been reduced the same. The amount that might have been saved at the mine is $4,500, whereas at the mill it is $4,050. This, of course, is strictly hypothetical, showing that the chance for cutting the total cost is 10 per cent greater in the mine than at the mill.

Omitting the easy figures assumed in this case, it may be stated as a general rule that the chance to reduce cost in the mine is greater than in the mill, because the miner's net is always the millman's gross. The corollary follows: A ton of ore saved in mine extraction is saved at less cost than a ton saved in concentration. It is assumed that the term "saved" connotes husbanded by application of knowledge of engineering and economical methods.

Considerable discussion of these propositions is possible, and data are available for arguments pro and con, but when all the statistics have been presented the logical conclusion is that experimentation in the mine is just as valuable as experimentation in the mill. Millions of dollars have been spent in commercial and college laboratories, in government and school experimental metallurgical plants, perfecting ore-treatment processes. As compared with this activity only a relatively small amount has been spent in collecting data on extraction methods in the mine.

Believing that the collection of such data is of prime importance, the Colorado School of Mines maintains an experimental mine at Idaho Springs, Colo., as a working laboratory for purposes of instruction, experimentation, and tests. The School welcomes the use of this mine by those industries

that have mining research to do or problems in experimentation to solve. The facilities of the School of Mines have been placed at the disposal of such companies. Several concerns are taking advantage of this arrangement at present, and all developments and information discovered in their experimentation are held in strict confidence and become the property of the respective concern conducting the work.

Those directing the Colorado School of Mines believe that such a mine maintained for experimental purposes offers a particular advantage that is impossible in operating mines. In an operating mine, the business of first moment is to *produce,* and hence it is seldom possible to control conditions so that any given factor may be changed at will. Inasmuch as the value of scientific experimentation rests in the axiom that only one factor at a time be varied, the experiment must be conducted at a place where all conditions may be controlled. The expense of maintaining such a place prohibits individual mining companies, machinery and explosives manufacturers, colleges and others from undertaking the establishment of individual experimental mines. But with the cooperation of several who mutually benefit from the project, the cost to each is easily reduced to the allowable maximum, or below.

Let us consider some of the problems that may be undertaken in an experimental mine. The mining engineer's knowledge of underground forces with which he is dealing, whether it is a matter of resistance in mine support or in caving operations, is limited. It seems possible to obtain data on these forces by employing modifications of geophysical methods now used in surface prospecting. At present the geophysicists are using earth vibrations and resistances as a means of deducing the nature of unseen strata far below the surface. These phenomena might be equally as useful in the control of mining operations. Common mine blasting, caving of ore, drill vibrations, change of excavated volumes seem to be sources from which control data could be gathered.

Much remains to be done in the laboratory, but here the experimenter meets with the difficulty of reducing measurements to laboratory scale. The mining engineer in underground excavation problems meets with conditions, let us say, similar to those confronting the construction engineer and architect in erecting a skyscraper. Too often the mining engineer is working in ignorance of strengths, loads, forces, and other factors that he should know. Though it is possible for the construction engineer to reduce his measurements to laboratory scale, and for the architect to build an actual model to scale, it is not always possible for the mining engineer to do the same. Even where laboratory tests are possible, it is well to prove the results in an actual mine.

Such tests apply not only in research and experimental work but as well in the case of mining supplies, equipment, and machinery. As an example, a large manufacturer of rock drills is now making tests of new developments in the School of Mines experimental mine. The policy before had been to test the drills at the plant, using large blocks of granite, shipped in from the quarry. Following these limited laboratory tests

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MANY PROBLEMS call for engineering study. . . . Tests readily possible on a large scale, without interruptions of the work that would ordinarily occur where production is a first consideration. . . . School welcomes use of mine by industries having special work to do. . . . Chance to reduce costs underground is greater than in the mill

●

the drill had been placed directly in the hands of operators for further testing. In some cases where inadequate performance resulted there was experienced some loss of confidence in the company's products and control of tests was not in the hands of the manufacturer's technical staff. This is likely to be the experience of any manufacturer under the same conditions, if the manufacturer is attempting untried improvements. The particular concern referred to has found the experimental mine a satisfactory testing ground, and expects to prove every new idea thoroughly before releasing its product finally to the operators in the mining industry.

Some Problems

Numerous cases of similar nature might be expanded here but for the necessity of limiting the discussion. Suffice it to list in a sort of outline form the nature of some problems that might be worked out in the experimental mine:

1. Tests of solid- and detachable-bit machine drills under the varying conditions of heat-treatment of steel, alloys, hardness of rock. Machine drills may be tested for endurance and efficiency, under carefully controlled variation of factors that are not possible to control in the operating mine.

2. Tests of explosives under varying conditions of strength, burden, life, moisture, amount, and time.

3. Tests in the efficiency of blasting, exclusive of those enumerated under explosives, including location of drill holes, burdens, calculation of forces, rock coefficients, size of product, energy relationship of amount, and size of material broken.

4. Tests of fans for main and partial ventilation systems. Air measurements, rubbing coefficients, eddying currents, velocity, temperature, moisture, leakage, auxiliary currents, and season modifications and other factors of mine ventilation.

5. Haulage, tests of rail weight, car and motor bearings, track support, economies in the preservation of ties, effect of corrosion, smoothness, and dirt on rails.

6. Tests of safety devices, hoist equipment, effect of alignment, guide and track equipment, dynamometer tests.

7. Rescue and safety. The various sections of the mine permit shutting off for the provision of all conditions of gas and temperature for the testing of rescue equipment and the training of rescue teams.

8. Drainage—tests of pumps, water lines, rate of corrosion, and support of ditches.

9. Geophysics, study of various instruments, and especially the application of geophysics in the study of underground forces and control of operations.

10. Timber, long and short and periodic tests[1] of timber in the mine. Kinds of timber, condition, points of failure, deterioration rates, effect of air conditions, preservatives, fireproofing, temperature, pressure, and other factors.

11. Study of underground stresses and forces both from the standpoint of their resistance in mine support and their use in ore excavation. Application of mechanics and physics in mining.

12. Mine dust. Tests of amounts and size of dust. Methods of dampening or collecting.

Although the experimental mine is not the largest mine in the world, its size is sufficient to provide working room in solving many problems. It is the old Edgar mine. There are three entrances. These are the Miami tunnel, the Big Five tunnel, and the Edgar shaft.

The Miami tunnel crosscuts the country rock for a distance of 2,000 ft. to intersect the Edgar vein. Along this vein is a drift extending some 1,500 ft. to the Edgar shaft, which is inclined at

[1]The School is conducting extensive research at present on these problems.

an angle of 80 deg. from the horizontal and extends 250 ft. to the surface. Below the drift, along the Edgar vein, are the Roy and Brown raises extending down to the Big Five level.

The Big Five tunnel is 300 ft. below the Miami, and has been driven 8,000 ft. through the country rock. It cuts across many veins that are supporting producing mines. At 2,465 ft. from the portal the Big Five intersects the Edgar vein on which the workings of the school mine are maintained.

From the collar of the Edgar shaft on the slope of the mountain the vein outcrop extends upward about 1,000 ft. This top part of the vein is developed by adits and one vertical shaft. The Edgar vein has been stoped upward from the drifts driven from the various levels. These stopes are maintained for use in student mine surveying and in the study of principles of underground excavation and support. They may be excavated further in working on problems of support and caving.

The school has erected three buildings on the property near the entrance to the Miami tunnel. These are a main office building, a blacksmith shop, and a compressor and machinery house.

A person or organization desiring to conduct a prolonged research may, with the consent of the president of the faculty and the board of trustees, establish a fellowship at the school under the general supervision of the directors, to cover a given period, and the fellow may give all or part of his time to special research work. In the latter case, the greater part of his time will be devoted to special research and the remainder to graduate study.

The party establishing the fellowship shall pay the salary and compensation insurance of the fellow and the actual cost of material, labor, power, and other incidentals necessary for the research work. If so desired, the director and his staff will supervise the work of the fellow.

All data and reports must be filed with the directors upon completion of the work or whenever they may be requested. Under any condition, the reports will be made a matter of public record after a period of two years from the completion of the test; but if so requested in the brief, they will be held from the public for that time.

It is expressely understood that the name of the school shall not be used in connection with the results of tests at the experimental mine as a basis for promotion schemes or the sale of stock, and that no data shall be published as coming from the School of Mines by the parties performing or contracting for the work without the permission of the board of trustees.

Special research problems of a general nature, relating to mining, preferably those having a bearing on the mining industry of Colorado, are studied by the directors and their assistants, with the approval of the president of the faculty, in so far as time and funds are available. Research problems, in the sense here used, are those dealing with fundamental principles, or with subjects having a broad general application, as distinct from problems dealing with one particular project. As soon as valuable and conclusive results are obtained, reports of research work are published by the school, or otherwise given to the public, but no private or advance reports will be given out during the course of the work.

This experimentation and research is encouraged among the members of the mining faculty, and the experimental mine has been opened to commercial concerns because those directing the School of Mines believe that underground operations are, at the present time, conducted without the support of much needed engineering data and control. Increased efficiency and lower cost will result from development of fundamental formulas and the application of them in the mine. This has been recognized in the field of metallurgy, where much time, effort, and money are spent yearly in improving recovery methods and in lowering costs. It is obvious that we need even more to make improvements in mining recovery and cost, for the miner's net is the metallurgist's gross!

A Feldspar Producer In Colorado

Western Milling Company is today practically the only operator in the State, which now ranks third in output—Has twenty or more deposits, of which it is working seven

S. A. Ionides

Vice-President
Western Feldspar Milling Company,
Denver, Colo.

FELDSPAR is a common mineral in Colorado, being a constituent of all the granite rocks. Commercial deposits are found in the form of pegmatite blowouts. These pegmatites are plentiful, particularly along the front range of the Rocky Mountains, but few contain the requirements for profitable operation, such as an analysis high in alumina, potash, and soda and low in iron, ability to yield approximately 40 per cent of the quarried material as shipping product, and a location within a few miles of a railroad.

The Western Feldspar Milling Company is practically the only producer of feldspar in Colorado today. It has conducted an extensive search for occurrences of the mineral and now owns or leases about twenty or more of them, scattered through the State, although it is operating only seven. Its principal operations are concentrated at two points, one near the Royal Gorge, about 10 miles west of Canon City, and the other near South Platte. At the first-named point two deposits are being worked—the Mica Hill and the School Section. Near South Platte, five quarries have been opened.

The Mica Hill deposit consists of an extensive blowout and has supplied the greater part of the company's output up to date. It is worked in an open cut, the face now being 100 ft. long and 80 ft. high. It is broken in places by mica pockets; hence its name. This mica is sorted and sold separately. The feldspar fines are all discarded, owing to danger of contamination, inasmuch as commercial specifications for feldspar are quite severe. Approximately 40 per cent of the rock mined is hauled to Canon City for shipment to the company's mill at Denver.

The School Section deposit is leased from the State of Colorado. It is flat, with very little overburden. A gulch at the west end gave the opportunity of starting in with an open cut, which has been driven in to expose a 25-ft. face. This feldspar is very hard to drill, so that mining is more expensive at this point, and it is not worked as heavily as is the Mica Hill deposit.

At South Platte, the feldspar is found in a number of blowouts, the outcrops of which are commonly white quartz. When this is removed, the feldspar is exposed. This, too, is of high quality,

and the deposits have the advantage of being much nearer a railroad point, the haul usually not exceeding four miles. The blowouts favor the hilltops, which fact renders them less easy of access and caused the building of two miles of road and a bridge over the Platte River to give connection to the main highway leading to South Platte, the shipping point. The company has its own loading docks at both Canon City and South Platte.

Quality is all important in this industry. If it were not for the quality and size of the deposits in Colorado, the industry could not exist, inasmuch as long rail hauls to market are required in nearly every case. For the same reason costs must be kept low. Great credit for accomplishing this is due to John Magnuson, the president of the company, and his sons, particularly Ralph Magnuson, who is in charge of the mining work. As the result of their efforts, combined with the natural high quality of the Colorado rock, the State, which was not even listed as a producer seven years ago, now has the third largest output of feldspar in the United States, being exceeded only by North Carolina and Tennessee.

A typical analysis of carload shipments follows: Alumina, 19.4 per cent; potash and soda, 14.75; silica, 65.6; and iron oxide, 0.07.

The mining method is simple. The rock is broken in benches, and the feldspar loaded into mine cars and hauled to a trestle, where the cars are dumped direct into trucks, each of which carries the contents of four mine cars. The trucks are backed onto the loading dock and into the box cars and the contents dumped. All shipments are made in box cars to prevent contamination.

Of the 60 per cent that is not shipped, as much mica as can be sorted reasonably clean is placed in a separate pile and the remainder is used for road construction or just piled into a waste dump.

Other pegmatite minerals are found occasionally in the dikes, such as beryl, columbite, and tantalite, but not in sufficient quantity to make them of commercial importance.

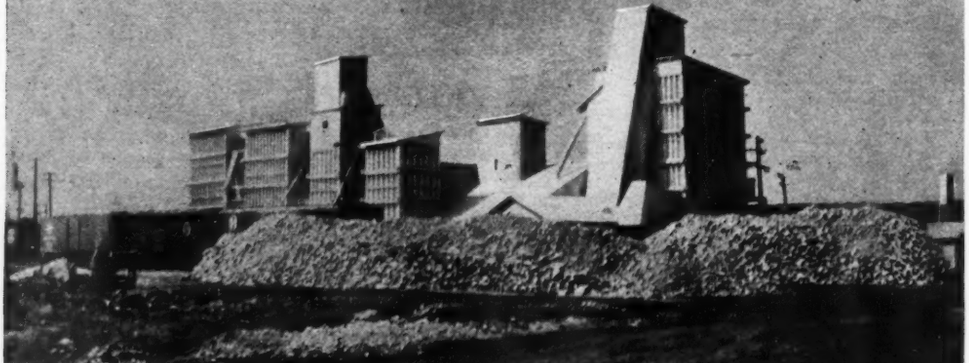
Feldspar rock is also bought from other quarries and mixed in grinding, so that material uniform as to specifications can be shipped. The blending of the rock from the various quarries is a very important step in the preparation of ground feldspar.

During the fall, large quantities of rock are stockpiled at the plant, to insure prompt shipments in the face of railroad blockades due to snow or other causes.

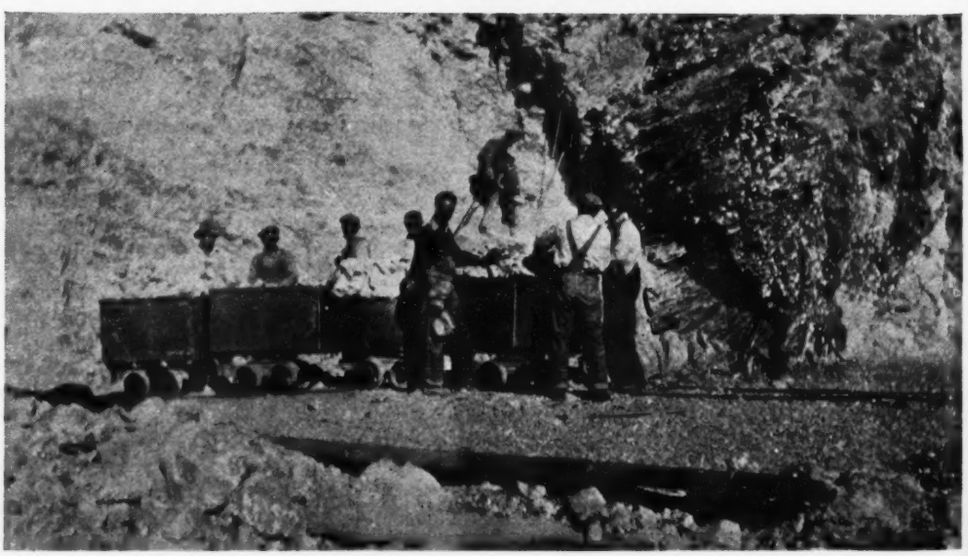
The mill is situated in Denver, with railroad tracks on both sides of it. The feldspar rock is unloaded on the west side into a 9x16-in. Universal jaw crusher, where it is reduced to 1½ in., and is then transferred by a belt conveyor to an Allis-Chalmers No. 5 Newhouse fine reduction crusher, where it is further ground to ¼ in., after which it is put through a 20-mesh screen. Oversize goes to a 7x6-ft. Allis-Chalmers pebble mill. The product is again passed over a 20-mesh screen and the oversize is ground in a 8 ft. by 60 in. Hardinge conical pebble mill in closed circuit with a Gayco cyclone separator.

The minus 20 mesh is elevated, further screened, and distributed among five storage bins, which have a combined capacity of 1,200 tons, from which the ground feldspar is loaded through chutes into box cars on the east tracks. At an early stage in the grinding, the rock is passed through a magnetic separator and a dust collector to remove contaminating iron and vegetable matter.

Five grades are made to meet the varying requirements of the company's customers. Shipments go to the Pacific Coast, Mexican border, and as far east as Indiana.



AT THE PLANT of the Western Feldspar Milling Company, in Denver. Railroad tracks serve it on both sides. Here in the foreground is a stockpile of crude feldspar. Rock from several quarries is mixed previous to grinding



ONE OF THE QUARRIES of the Western Feldspar Milling Company. The light-colored rock is feldspar, the dark streak is mica, and the remainder is common wall rock

NEWS
OF THE INDUSTRY

American Mining Congress Discusses National Problems and Policies

Labor Relations, Social Security, Taxation, Silver Purchase, and Other Federal Legislation Affecting the Mining Industry Hold Major Interest for Delegates

DEVOTING its attention principally to economic matters growing out of New Deal legislation, and appraising its future effect on the metal-mining industry, the Western Division of the American Mining Congress met in Chicago Sept. 23-27. Coincident with the convention there was an exposition of mining equipment and supplies at which manufacturers exhibited their latest machines for mining and milling operations. Mineral-resource exhibits were staged by Colorado, Illinois, Texas, Utah, the Tri-State district, and the iron-ore district.

By order of the board of governors, the next meeting of the Western Division will be held in Denver in the fall of 1936.

The Chicago program was characterized by a rather bewildering array of topics in which technology was subordinated to economics. Operators were more interested in the effect of recent Federal legislation on mining as a business than in the usual problems of production and distribution; and they attracted to their program speakers of authority and national prominence, including Lewis W. Douglas, former Director of the Budget; F. H. Brownell, chairman of the board of the American Smelting & Refining Company; C. K. Leith, vice-chairman of the Planning Committee for Mineral Policy; John M. Carmody, member of the National Labor Relations Board, and Edwin E. Witte, advisor to the Social Security Board.

Silver Sense

There has been so much loose talk about silver by both opponents and proponents of the Government's silver-buying policy, that it was refreshing to hear F. H. Brownell's analysis of the situation and his defense of the conservative procedure of the Treasury in carrying out the provisions of the Silver Purchase Act. The fundamental intent of the law is not, as some seem to believe, to buy as fast as possible the amount of silver necessary to establish a 1:3 ratio of silver to gold in our monetary stocks, and promptly raise the price of silver to $1.29 per ounce. The effect of such a procedure would create confusion in other monetary systems of the world and would exhaust our buying capacity before world stabilization of currencies could be accomplished. Mr. Brownell believes that the best interests of all concerned will be served by maintaining the foreign price of silver between 60c. and 65c. per ounce until the United States has purchased the silver required by the purchase act. The higher price is too near the "melting point" of foreign coinages and of fabricated silver. The remaining buying capacity of the Treasury is probably 1,100,000,000 ounces, and this can be acquired in the next five years from current world production plus the quantity available from India and from floating stocks. The long-run prospect for silver depends on its enlarged use as money when world currencies are stabilized, and this prospect will be enhanced by a conservative buying policy by the United States. The outlook for the metal is brighter than at any time in the past fifteen years.

Utilization of minerals and their importance in the development of industry were presented in a paper by John W. Finch, Director of the Bureau of Mines. Dr. Finch emphasized the need for purposeful planning in the exploitation of our mineral resources, and outlined the economic and technologic work of the Bureau for the industry. Other papers dealt with the uses of the major metals and showed that, although some new uses are being found, nevertheless the "bread and butter" of the producers is to be found in the established tonnage outlets.

Measures designed to stabilize mineral production and keep it reasonably in step with consumption were discussed by C. K. Leith and Robert E. Tally. These proposals, which are based on the exhaustible character of mineral deposits and involve their conservation in the public interest, have previously been presented by both speakers and published. (*E.&M.J.*, Jan. 1935.) They involve permission to the mining industry to enter into trade agreements on production, with relaxation of the provisions of the anti-trust laws, in return for a minimum of governmental supervision and control. These policies have been extensively studied and published by the Planning Committee for Mineral Policy, but no legislation has been prepared. Doubtless a campaign of education must be carried on for a time until the industry sees the wisdom of cooperative action among its own units and the Government before formal action is taken.

Government and Industry

By far the majority of addresses and discussion dealt with governmental policies and industrial legislation. The high spot of interest and enthusiasm was developed by Lewis W. Douglas in his talk on "Government Spending of the Taxpayer's Money." Citing the successive annual Federal deficits since 1931, which now total more than 14 billion dollars and may reach as much as 20 billions for six years, Mr. Douglas maintained that unless excessive spending is stopped the inevitable result will be the destruction of the currency. He drew on historic examples,

(*Continued on page* 517)

California Gold-Dredging Operations Expanding Throughout the State

New Bucket-Type Units Begin Exploitation in Mokelumne and Bear Rivers—Dragline Operations Increase in Lincoln and Oroville Areas—Yuba Consolidated Announces Development Plan—Selby Strike Settled

AT COMANCHE two new dredges have been placed in operation recently. Comanche Placers, Ltd., has a 2½-cu.ft. dredge working on a large gravel deposit about a mile from the Mokelumne River, and on the north side of the river, Comanche Gold Dredging Company has started a 7½-cu.ft. dredge on the old Foster place. The 2½-cu.ft. unit is of sectionalized construction and will dig 16 ft. below water. Parts of a dredge shipped from Mexico were used in the construction of the dredge operated by the Comanche Gold Dredging Company.

✦ Tuolumne Gold Dredging Corporation is testing ground at its property, near La Grange, with two Keystone drills in operation under the direction of Crosby Keen, field manager. The company has recently obtained approval for a $630,000 RFC mining loan.

✦ A. C. VanDeinse, vice-president of Yuba Consolidated Goldfields, announced a $2,500,000 development program to be undertaken in northern and central California during the next three years. The greater part of the money will be utilized in replacing and rebuilding dredging equipment and improving the areas now under exploitation, including replacement of two of the three units operated by its subsidiary, the Capital Dredging Company, near Folsom, by one large dredge. Apart from a new dredge now under construction on its property below Merced Falls, the company is reported to be dismantling the sectionalized dredge near Avon, Mont., for shipment and re-erection at Snelling.

✦ Drilling operations are being conducted by the Lancha Plana Gold Dredging Company on the G. B. Podesta place, near Wallace, and at Buena Vista. The company plans to erect a new dredge at either location, and is now dismantling the old unit at Lancha Plana. The pumps and other equipment are to be overhauled for use in the new dredge.

✦ The Gold Hill Dredging Company, C. H. Thurman, manager, has started operations with a new 8½-cu.ft. all-steel dredge, Loomis No. 1, in the gravels of the channel of Bear River, about 3 miles east of Loomis. The unit was designed by the W. W. Johnson Engineering Company, of San Francisco, and contains, besides the conventional gravel-treating machinery, an 8x32-ft. gravel mill, driven by a 200-hp. motor to wash and disintegrate the semi-cemented gravel thoroughly before it enters the revolving trommel screen. In addition to this dredge, the company operates a 9-cu.ft. boat in the Folsom area. A portion of the expansion program of the company was made possible by a $240,000 RFC loan approved recently.

✦ Increased activity also prevails in the dragline dredge branch of the dredging industry. New units have been placed in operation in the Lincoln and Oroville areas, and George de Lisle is reported to be operating a dragline on the Raggio ranch in the Jackson district.

✦ Spring Hill Gold Mines, Inc., has started production at the Spring Hill mine, at Grass Valley, and the new 100-ton flotation plant completed recently is reported to be working satisfactorily. H. R. Plate is resident manager of the company.

✦ A new flotation unit is being installed in the mill at the Silverado mine, situated in the Sweetwater district, Mono County, and operated by the Sierra Consolidated Mines, Inc., supported by New York interests headed by J. J. Rascob. The extra equipment will raise the capacity of the mill, which was partly destroyed last winter, from 60 to 100 tons, and operations are expected to start early in October. The company has also rebuilt the destroyed bunk and boarding houses, and plans to electrify the main haulage tunnel on the 600-ft. level. Work at the mill is under the direction of Howard Squires, and D. C. McKay is mine superintendent.

✦ A 100-ton mill is in course of construction at the property of the California Standard Gold Mines Corporation, situated near Stent. The ore is to be crushed in two stages by a Blake jaw crusher and a Symons cone crusher, which is to be followed by grinding in a Hardinge ball mill operating in closed circuit with a Dorr classifier. Flotation equipment consists of an eight-cell Denver Sub-A machine, from which concentrates go to a Dorr thickener and an American filter. The tailings flow to a Dorr thickener before going to the waste dump. A. F. Muter, Los Angeles, is president of the company.

✦ According to a report from Mojave, Golden Queen Mining Company, which has recently acquired the famous Silver Queen mine, on Soledad Hill, near Mojave, has purchased a half interest in the Queen Esther mine, situated just east of the Golden Queen. The Queen Esther was operated by the late Col. Seeley Mudd until 1911, and since that time the property has been idle. His son, Harvey Mudd, of Los Angeles, possesses the other half interest. The claims adjoining the Golden Queen mine known as the Starlight, Gypsy, Gray Eagle, Echo, Soledad, Santa Ana, Oro Fino, and Carolyn are said to have been optioned by New York interests headed by John Rogers, who has several crews at work in the Starlight and Gray Eagle tunnels.

✦ The strike at the Selby smelter of American Smelting Refining has been terminated following conferences between the management and the employees' committee, and about 400 men returned to work on Sept. 4.

IN BRITISH COLUMBIA. The Detonia Mines, Ltd., removes gold ore from the company's Jewel Mine, which is treated in its 100-ton flotation plant. The mine is located in the Greenwood Mining District

(Continued from page 515)

ancient and modern, in support of his contention, and showed the social and economic significance of a destroyed currency. In his judgment the way out lies in a courageous balancing of the federal budget at 5¼ billion dollars.

Taxation, the necessary accompaniment of governmental spending, was discussed by E. C. Alvord, tax counsel for the American Mining Congress. Per capita expenditures have exceeded revenue since 1931, and for 1935 stand, respectively, at $60 and $33. For 1936 they will be $68 and $33. Drastic action will be necessary if a balance is to be obtained. Assuming a conservative Federal budget of 6½ billion dollars, Mr. Alvord saw no escape from raising additional revenue by imposing a general sales tax and by levying income taxes on "the little fellow." Regardless of what is done, heavy taxation is in sight for many years to come.

Safety and Health

Mining has the worst severity rate and next to the worst frequency rate of 30 main industries in the United States. In an effort to remedy that condition, Dan Harrington, safety engineer for the Bureau of Mines, laid down seventeen definite suggestions for safety organization and accident prevention in metal mines. His primary recommendation was that safety work should be made a matter of executive concern and leadership, and not left to subordinates altogether. All mining organizations, large and small, should take advantage of the aid in safety work that the Bureau stands ready to offer.

The significance of silicosis in mining was discussed by D. E. Cummings, of the Saranac Laboratory, who pointed out the preventable nature of silicosis and admonished the mining industry to take immediate steps to control this disease. H. M. Lavender and G. B. Lyman, engineers of the Phelps Dodge Corporation, Bisbee, Ariz., presented a method of underground dust control involving the use of common salt, both solid and in solution, as a hygroscopic agency for reducing the circulating dust load without increasing humidity.

Labor and Social Security

Although the Labor Relations Act and the Social Security Act are now the law of the land, several speakers addressed their remarks against the inequities of the former and the burdens of the latter. There was an insistent demand that labor organizations be made responsible for their acts, so that both parties to labor agreements would be competent and equally subject to the enforcement of judicial decisions. The prospective burdens of social security were probably overdrawn, but an analysis of the act shows that heavy taxation must be levied to meet old-age pensions and unemployment compensation.

Dewatering of Mines in Missouri Oronogo District Almost Completed

Properties in This Long-dormant Lead-Zinc Field Will Soon Be Scenes of Revived Mining Operations—Oronogo Ore May Be Shipped to Central Mill—The Commerce Mining and Royalty Company Is Improving the Bird Dog Mill

THE CHILDRESS interests have almost completed the dewatering of the Oronogo bottoms since they installed an 18-in. Pomona pump with a capacity of 6,000 gal. of water a minute. One of the 14-in. Pomona pumps, which was stationed in the Oronogo bottoms, has been moved to the Oronogo Mutual mine so as to dewater the Mutual and the famous Oronogo Circle properties. An early resumption of mining in the Oronogo district is anticipated after dewatering. With the exception of some gouging and desultory mining, these mines have been idle for about eighteen years.

✦ The Eagle-Picher company has displayed some interest in the Oronogo district and possibly some ore from that district may be transported to the Central mill, a distance of 30 miles, for treatment.

✦ The Cortez-King Brand Mines Corporation, which is treating tailings over its King Brand mill, is reconstructing the Cortez mill and expects to have the plant ready to operate within a few weeks. The company has almost completed the re-treatment of the King Brand tailings and will discontinue that operation when the Cortez mill is completed.

✦ C. F. Denney and associates have purchased the old Conico Mining Company's lease and mill. 11 miles northeast of Joplin, and will re-treat the accumulation of old tailings, operating under the name of the Roadside Mining Company.

✦ The new tailing mill of the Tri-State Zinc, Inc., a subsidiary of the Consolidated Gold Fields of South Africa, has recently started operations. The plant is located on the Mary Whitebird allotment in Picher. The Tri-State Zinc, Inc., is also operating a large tailing plant in the Picher section. The Missouri Mining Company, a subsidiary of the Tri-State company, is operating a mill at Chitwood, in Joplin. These three plants will have a weekly production of approximately 400 tons of zinc concentrates.

✦ The Mid-Continent Lead & Zinc Company and the Eagle-Picher Mining & Smelting Company have completed an agreement which gives the Mid-Continent company an enlarged acreage to mine, as the Eagle-Picher requires additional ore for the Central mill. Mid-Continent sold its mill and other equipment to the Eagle-Picher company for a consideration said to have been $50,000. Mid-Continent in turn received the mining rights on the Tulsa-Quapaw, Grace B No. 2, and Longacre lease, which adjoin the Mid-Continent lease. All of the ores mined on the tracts will be treated over the Central mill of the Eagle-Picher company.

✦ The sinking of the shaft at the Unity mine lacks about 20 ft. of reaching the projected 170-ft. level. A compressor is now being installed at another shaft of the Unity, and when track laying, together with other underground preparations, is completed, operations are expected to begin. The ore from the Unity will probably be milled at the Central Mill of the Eagle-Picher Mining & Smelting Company, near Commerce, which is approximately 35 miles from Oronogo.

✦ Three PWA projects have been submitted, the objectives of which are diking, damming, and ditching around old mines in the Oronogo and Webb City-Carterville districts. The three projects require an expenditure of approximately $165,000.

✦ The American Zinc, Lead & Smelting Company has purchased the Robinson mine of the Kansas Exporation Company, a subsidiary of the St. Joseph Lead Company, in the Treece (Kan.) section. The smelting company is unwatering the property and repairing the mill for an early reopening.

✦ Dines Mining Company is repairing the old Blue Mound mill of the Century Zinc Company, north of Picher, in the Kansas field, and expects to reopen the property before the end of the current month.

✦ Canadian Mining & Development has reopened its mine near Hockerville, Okla.

✦ Commerce Mining & Royalty is making some improvements to its Bird Dog mill, which will enable the company to handle ores from many different fields in the west end of the Picher district. The company expects to operate the mill at capacity very soon. The plant is the second largest in the field. Production of zinc ore has reached the 9,000-ton level for the first time in more than five years.

Arizona Mine Employment Higher as Copper Mines Expand Operations

Inspiration Consolidated Copper Company to Resume Working of Its Mines and Leaching Plant After a Three-Year Shutdown—Phelps Dodge Corporation Announces a 25 per Cent Production Increase

PRESENT INDICATIONS point to a general upward trend in the Arizona copper-mining industry during the last quarter. The revival of industrial activity in many parts of the country has demanded a greater consumption of copper and has also increased the price to the former NRA level of 9c. In order to keep the domestic supply above the current demand some copper companies have resumed mining operations or increased production. An important feature of this resumption is the announcement by the Inspiration Copper Company that it is planning operations of its mines and leaching plant about Nov. 1, after having been shut down since June, 1932. Phelps Dodge Corporation has announced a 25 per cent increase in production for some of its Arizona mines. Employment at most of the major copper-mining companies will probably show a definite increase this year compared with a year ago and may continue to rise during the remainder of the year.

✦ The Bisbee local of the International Union of Mine, Mill, and Smelter Workers voted three to one to discontinue the strike at the Copper Queen mine which had been in progress since June 10. Only a few miners had responded to the strike call; therefore, production at the property had not been affected.

✦ Oatman Eastern is shipping 60 tons of ore daily from the Ruth-Rattan mine to the Telluride mill of Johnston & Witcher.

✦ Holmes Mining, Courtland, has completed dewatering and retimbering the No. 6 shaft to the 200 level, where track is being laid to facilitate mining the gold-silver ore.

✦ Gold Standard Mines, owner and operator of the mill built to replace the old Katherine mill when it was destroyed by fire last fall, has acquired title to the Katherine mine and to the Portland Mines Company. The latter has been shipping 50 tons of ore a day to the Gold Standard mill since abandoning plans for a mill at the mine.

✦ At Chloride, the shaft of the Tintic mine has reached the 120-ft. level, and crosscuts are now being driven to the vein.

✦ Arizona Molybdenum, Copper Creek, is mining 300 tons of molybdenum ore a day, and milling 150 tons. Power is supplied from the Coolidge Dam over the recently completed power line.

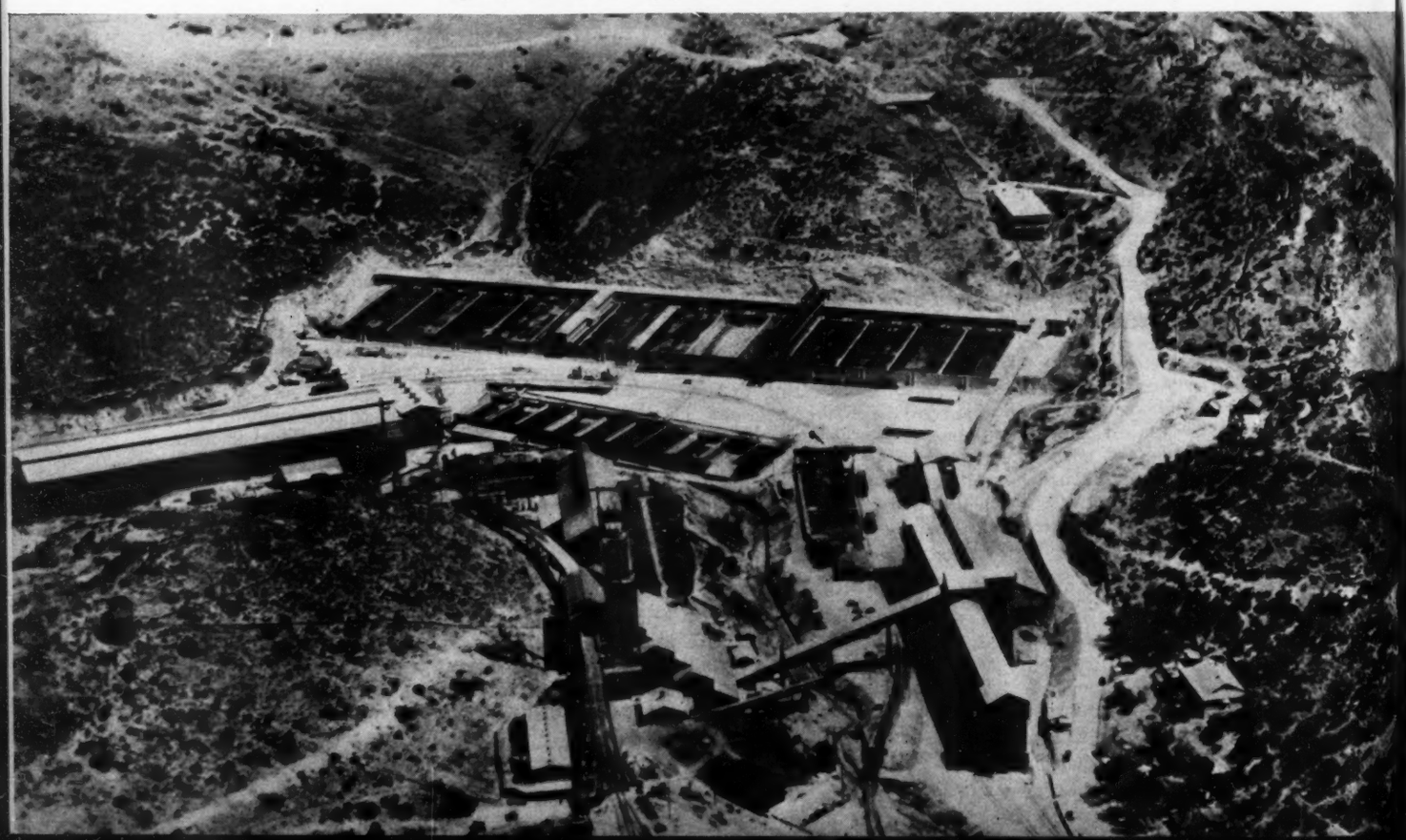
✦ The new 50-ton mill of The Arizona Magma Company, at Chloride, was placed in operation recently. Milling operations will be on a three-shifts basis.

✦ Southwest Smelting plans to construct a small smelter on the Colorado, 40 miles north of Yuma, to handle silver ores that are being developed in the district.

✦ Calizona Mining & Milling has leased the old Tri-Bullion property in the Stanley Butte district of Graham County.

✦ Johnston & Witcher, Inc., has been formed to provide a single organization to control the rapidly expanding holdings of Rae L. Johnston and Ray S. Witcher.

The leaching plant and mines of the Inspiration Consolidated Copper Company, in Arizona, which were shut down in June, 1932, will soon be in operation again on a 35 per cent capacity basis, or about 7,000 tons of ore daily. The maximum capacity of the leaching plant shown in the background is about 9,000 tons



NEWS FROM WASHINGTON

By Special Correspondent

ELECTION FACTORS and prospects are rarely discussed so long ahead of the actual voting day as is now noted in Washington. Every administrative ruling, every letter that becomes public, every opinion quoted in the press, is carefully scanned with a view to determining its effect in November, 1936. One naturally wonders whether so tense a political situation can possibly last more than a year longer.

The promised "breathing spell" for business has perhaps occasioned more jitters than peace of mind. The very fact that the President by his statement tacitly admitted that business had been worried by his actions seems in many minds to have accentuated the need for it. But the public reaction, so political leaders say, was favorable. If so, the desired result was had regardless of what business thinks.

Munitions Control

First steps were taken in late September to provide a mechanism for registration of companies manufacturing arms and munitions. The new Office of Arms and Munitions Control within the State Department will function in accordance with policies fixed by the Munitions Board, which consists of the Secretaries of State, Treasury, War, Navy, and Commerce. R. Walton Moore, Assistant Secretary of State, will supervise the work, which is under the active direction of Joseph C. Green as chief and Charles W. Yost, assistant chief.

The act requires that the board register and license all manufacturers and exporters of "arms, munitions, and implements of war," before Nov. 30. There is no provision for denying a license, but exports may be regulated under orders of the President. In all cases publicity is to be given production licenses, and particularly all permits for future arms *shipments* to foreign countries.

From the standpoint of the mineral industry the crucial test will come in the matter of definitions. No one yet knows just what limits will be set; for example, whether copper is a "munition." The status of several other minerals also requires clarification.

Ethiopian developments of large importance to the mineral industry are being influenced by the Secretary of State, presumably somewhat guided in his thinking by other Cabinet officers. His action early in September in securing a repudiation by petroleum executives of a planned Ethiopian mineral concession had importance far beyond that first apparent. This action of Secretary Hull was perhaps of direct aid to Mussolini, who was apparently depending on promises to Italian groups for financial aid. It is reported, without verification, that these groups were reluctant to make immediate money commitments in aid of military effort if the title to the mineral rights which they were being promised was to be clouded seriously by grants made legally by Selassie to American and British groups.

The full details of the negotiations and plans that follow will probably never be known. Certainly, in late September Washington continues seriously in doubt as to the real implications of the Hull action. Furthermore, Washington confidently believes that it has not yet heard the last of this case.

Tariff Troubles

THE STATE Department continues to have fundamental difficulties in negotiating further trade agreements. Most significant for the mineral industries of recent episodes in this field is the release of the communications between Secretary of State and the Canadian authorities.

Two paragraphs of the Canadian requests ask for:

The reduction by 50 per cent of the existing United States rates of duty, as authorized by the Tariff Act of 1934, on a specified number of natural products, including, *inter alia,* lumber, fish, potatoes, milk and cream, and live cattle; a number of other agricultural products, and several minerals both metallic and non-metallic.

The reduction of the existing rates of duty by the United States on a number of partly or wholly manufactured products of Canada, including some processed natural products and certain products in which hydro-electric power comprises an important element in the cost of production.

Unemployment

Labor Day was seized as an appropriate occasion by A. F. of L. leaders to declare again the determination of organized labor to work for a 30-hour week and for increased wages and improved conditions of employment. The charge was then made by President Green that over five million employed workers had been detrimentally affected since the Supreme Court declared NIRA unconstitutional.

General Hugh Johnson later in the month undertook to define what he regards as a safer and saner course. His surprise program of five points admits mistakes of the New Deal, declares unswerving loyalty to the President, but implies that much of Alphabetic Washington deserves a vigorous crackdown, which he would like to give if he did not think it would embarrass his former boss.

Specifically he stated (as we read him):

1. The present WPA-PWA program is wholly impractical. It costs too much for the employment provided.

2. Relief should be provided only when states and cities can't bear their own burdens.

3. A new NRA should be enacted to shorten hours by cooperative arrangements and compulsory codes, but "rigid regislation like the Black 30-hour bill won't solve the problem."

4. Agricultural legislation is being so prostituted as to intensify the condition which it was intended to remedy.

5. Coordination of Administration agencies is necessary, for "they are running all over the lot."

Strangely enough, conservative Washingtonians think this is a bully program for those whom New Dealers call "Tories."

Fact Finding

Interdepartmental controversies have somewhat handicapped the aggressive development of mineral investigations. Part of the difficulty arose as a result of the law which transferred men, money, and authority of the old Minerals Division, Bureau of Foreign and Domestic Commerce, to the Economics Branch of the Bureau of Mines. Other controversies revolve around the scope of the statistical units which work directly under Secretary Ickes as Petroleum Administrator. The Bureau of Mines is, of course, involved, since it is by law the only agency generally recognized as having authority to gather the needed fundamental data.

Dr. Finch and his principal staff

executives rightly insist that their duties should end with fact finding. They are strongly averse to being drawn into policy-making questions which, in their judgment, lie outside the scope of the Bureau's duties. But the Bureau officials also, and with equal justification, insist that this fact-finding effort cannot well be dissipated by farming out part of the work to other bodies whose duties are primarily administration and policy making. The Bureau, with full justification, objects to having its reputation as an impartial agency laid open to question, as it might be if those engaged in administration should borrow the Bureau authority to gather and announce data.

Thus far, apparently, the industrial groups involved have supported the Bureau of Mines in its desire to continue dominant in this field, including the responsibility for issuing forecasts of anticipated consumption of products, notably petroleum. It is possible that this plan of estimating prospective consumption for petroleum will be extended to include other mineral products, such as coal, copper, lead, zinc, and perhaps some of the non-metallics as the program is expanded.

The Constitution

Any doubt that may have prevailed as to whether amendment of the Constitution was to be a major issue of 1936 was dispelled by the Constitution Day address of the Secretary of Commerce. An old political hand like Roper would never have made that address if he had not known that the President was willing to have the New Deal Gettysburg fought on constitutional ground. Thus the challenge of the American Liberty League, Big Business, and the Tories is definitely accepted.

Calmer critics, those who wish to progress in an orderly fashion, but do not like all of the New Deal extra-constitutional ideas, are now arguing in Washington that to have real influence in these matters one must take a conservative middle ground. But no industry, least of all a vitally concerned resource industry, is likely to be neutral on so fundamental a matter. The mining industry, especially, may find itself in more fog than is justified, with all this hot air which rises in Washington and descends in what should be cooler and calmer areas of the country.

Regardless of further legislation that may be attempted in 1937, regardless of what the New Deal may promise or seek in the election, regardless who wins in 1936, the industry can count on a steady movement in the socializing direction which has been irretrievably and irreversibly initiated. Even under a Republican administration there can be little turning back from the major objectives of today—even in 1937.

New Copper Code

A NEW voluntary code for the copper industry has been formulated. It is believed that the handling of this code was the subject of discussion at Hyde Park shortly after mid-September. Late in that month it was confidently expected that the code would soon be filed with the Federal Trade Commission by Harry King, spokesman of the group. Washington would welcome such action, would like to make a test case of it with respect to policy in handling important resource industries.

One phase of this matter is very important to all industries—namely, the fact-finding and statistical projects that will be involved. In this connection mineral economists again stress the three recommendations regarding copper which were formulated by the Planning Committee for Mineral Policy and made a part of the National Resources Board report, released last January. These three findings are:

1. Complete statistics should be provided covering all factors of supply and demand, including consumption and consumers' stocks as well as production and producers' stocks, and including scrap as well as virgin metal. Such market information should be deposited with one of the permanent Government mineral fact-finding agencies. The basic data should be compiled in the form of totals or aggregates and published promptly for the use of both consumer and seller.

2. Forecasts of consumption should be made by a public agency in collaboration with representatives of both producers and consumers as outlined in Section II.

3. Some limitation should be imposed on the piling up of surplus stock. It is assumed that the emergency control under the present NRA code will in time reduce stocks to manageable proportions. Thereafter we recommend limitation of stock accumulations by joint action of the trade, under supervision of public authority. If such joint action by the industry is forbidden by the anti-trust laws, we recommend consideration of such legislation as will authorize it under the necessary public supervision.

Some of the outstanding issues are most usefully phrased, though not politically well stated, about as follows:

1. How fast can social security be provided for the aged and for the unemployed without financial wrecking of Government or business?

2. How fast may closer participation of organized labor (not necessarily affiliated with A. F. of L.) be provided a part in the privilege *and responsibility* of management?

3. Can any way be found to give Federal authority to those who wish to maintain orderly development of natural-resource industries? Will a constitutional amendment be declared essential for this purpose by the Supreme Court?

4. When can the budget definitely begin to approach balance and how fast can it be forced toward that end, which is universally admitted to be vitally essential?

5. Do the people want some moderate revision of the Constitution tending toward Federalization of labor and social administration?

Supreme Court decisions, whatever they may be, will largely fix the answer to several of these questions during the coming winter. And Congressmen will come back from home districts much better informed as to what the people really want.

Mine Work Relief

Another month has passed without any work-relief projects being perfected to provide stranded miner populations with employment. The work-relief substitute for dole has gone at less than half the speed promised by the President on the basis of the Hopkins and Ickes plans. Friction between these twin managers of relief has, of course, been part of the trouble. More important, however, is the fact that it is physically impossible to make legal projects fast enough to reach the promised new useful employment for 3,500,000 persons by November. The trend, therefore, continues more and more toward the old, ill-reputed CWA type of made work.

Some State projects for work relief are still in the hopper at both PWA and WPA. For example, South Dakota wants to make a mineral survey, notably carrying out the projected Chamberlin manganese study already described in these pages (see *E.&M.J.* for September, p. 468). Little early success is expected for the promoters of such ideas.

If one wishes to go to fundamentals with reference to this problem, the real issue is clear. It is: How much disturbance will politicians (and the public) stand for in order to shift ne'er-do-wells who are very comfortably on dole back to their pre-relief status? It is estimated that at least three million such "employables" have always been odd-job folks earning as much as they could when they were willing to work part time and existing on the aids of neighborliness and casually organized charity for the rest. Such persons apparently make up fully a third of the nine or ten million persons listed as unemployed.

Nevada's Mining Industry Active—Building Mills and Reopening Mines

Sutro Tunnel Coalition Is Erecting a 250-Ton Mill at the Crown Point Mine Near Gold Hill—Weepah Nevada Mining Will Construct a 250-Ton Flotation Plant in Lone Mountain Area—Betty O'Neill Mine to Be Reopened

SURVEYS have been in progress for mill foundations and for rerouting the track of the Virginia & Truckee Railroad at Gold Hill, in preparation for the construction of a 110-ton cyanide mill at the Crown Point mine, owned by the Sutro Tunnel Coalition, which has been granted a $160,000 RFC loan to mine and treat ore on upper levels, developed by a shallow tunnel. A high railroad trestle stands directly over the orebody, precluding earlier mining in this area, and its removal involves making a deep cut through the ridge to the west and a fill across Crown Point ravine. E. L. Sweeney, of Denver, has been awarded the construction contract, and both mill and railroad work are to be completed within 90 days.

✦ A survey of the Comstock district geology is in progress under the direction of J. D. Johnstone, of the United States Geological Survey, assisted by F. C. Calkins and T. P. Thayer, petrologists. A preliminary topographical survey is nearly finished, its records in photostat form being available for the geologists, whose work may occupy several months. The last United States geological work in the district was conducted by Becker in 1881 and was confined to the eastern or hanging-wall area. Interest in the present survey centers in the footwall country and the fault system in this area, believed by Reid and others to have been the avenues through which enriching solutions reached the Comstock lode.

✦ Gold & Circle Mines, Inc., formerly known as Gold Circle Mines, is reopening the Betty O'Neal silver mine near Bottle Mountain. The long Getchell tunnel is being cleared, and a raise will be driven from the No. 2 tunnel to develop an important orebody. The company's operations at Gold Circle, in Elko County, also are to be expanded, as the Elko Prince shaft will be sunk to the 1,300-ft. level and a long haulage tunnel will open six of the mines below water level.

✦ In a reorganization of Sierra Consolidated Mines, with property in the Sweetwater range in California, near the Nevada line, John J. Raskob, Jr., and Robert P. Raskob, sons of the well-known financier, have been elected directors, with G. F. Morse, Denver machinery dealer, together with two Reno attorneys. The younger Raskobs also have been made directors of Consolidated Virginia Mining, which has been reorganized with capital of $5,000,000 and is negotiating to acquire, on a share exchange basis, the properties of Consolidated Virginia & Andes, Ophir Mining, and Mexican Gold & Silver Mining. Key Pittman, United States Senator from Nevada, was named a director but declined to serve other than as attorney for the participants in the merger.

✦ Long-term options on several "inside" mine properties at Goldfield have been obtained by Eastern Exploration, reputedly a subsidiary of Calumet & Hecla Consolidated Copper. Surveys and sampling have been in progress over a large area for the past eight months under the direction of Augustus Locke, assisted by a staff of engineers. Locke is said to have entered into a contract with Goldfield Deep Mines providing for a long-term lease to Eastern Exploration of all unexplored Deep Mines territory; and Deep Mines is granted a lease below the 600-ft. level on ground of Goldfield Consolidated Mines already under lease to Eastern Exploration.

✦ Construction of a 250-ton flotation mill is now under way at the property of the Weepah Nevada Mining in the Lone Mountain area, west of Tonopah, headed by Walter Haggerty, of New York. An 8-mile water line is being laid to the millsite from Millers Flats and a power shovel is employed in removing overburden from the orebody. The ore will be worked by the glory-hole method. A power line has been extended to the property.

✦ A flotation unit to treat 100 tons per day is being added to the 150-ton cyanide mill at the Silverado mine of Sierra Consolidated Mines, in which John J. Raskob, of New York, lately acquired an interest. Lou M. Louis has the construction contract.

✦ Manhattan, Nye County, has become one of Nevada's most active mining districts, and further large-scale development is indicated as a result of a consolidation embracing the properties of White Caps Gold Mining, Nevada Coalition, Manhattan Consolidated, and White Caps Extension. The merger has been ratified by the shareholders of the four companies. A mill is being built under the direction of E. S. Chafey to treat highly shattered surface schist that contains free gold in the fracture planes and will be loaded to trucks by power shovel. This project, titled Goldfields of America, embraces several of the early locations, including the Jumping Jack, Indian Camp, and Big Four mines. The War Eagle mill is treating ore from the Matt Kane mine, purchased by Randolph Crossley, of Honolulu, and the Consolidated mill treats the product of the Gold Metals mine. A number of lessees in the White Caps and elsewhere continue to ship high-grade base ore to Utah smelters.

✦ At Mountain City, northern Elko County and at high elevation, Mountain City Copper, a subsidiary of International Smelting, is constructing 25 cabins and is preparing to work a substantial mine force throughout the winter. Ore is being trucked to stockpiles at Elko at the rate of 100 tons per day, but reports from responsible sources are said to indicate that no large production will be undertaken for the present.

The crushing plant and flotation mill of the Arizona Comstock Corporation, located in Virginia City, Nev.

The present increased demand for copper arouses greater mining activity in the huge surface workings of the Utah Copper Company at Bingham, where operations have been on a reduced scale since 1930. Stripping the overburden on the orebody, shown above, may be said to be another chapter in the 70-year colorful history of this enormous copper mine where 23 electrically operated shovels are available for mining purposes

Utah's Non-Ferrous Mines Show More Activity as Metal Prices Climb

Utah Copper Company Places Two More Electric Shovels in Operation—United States Smelting Company Is Completing the Additional 500-Ton Flotation Plant at Midvale—Mine and Smelter Payrolls Higher

INDUSTRIAL RECOVERY, accompanied by higher metal prices, plus the buying of metal in the foreign markets for the exigencies of war, have stimulated the non-ferrous metal-mining industry in Utah, as well as elsewhere. Production at the Utah Copper mine, at Bingham, has been increased to 20,000 tons daily. International Smelting has reopened its North Lily and Big Hill mines, at Tintic, and on Oct. 1 will put into operation its copper smelter at Tooele, thereby employing 200 more men daily. The United States Smelting, Refining & Mining Company is rushing to completion at Midvale its new 500-ton flotation plant, bringing the total capacity up to 1,700 tons daily when completed between Nov. 1 and 15. The Mountain City Copper property of the International Smelting Company at Mountain City, Elko County, Nev., has augmented its production to 150 tons daily. Other signs that point to increased prosperity are the reconditioning of the Arthur mill of the Utah Copper Company, having a capacity of 30,000 tons of ore daily; a doubling of the number of men employed at the Garfield plant of American Smelting & Refining, and a rumor that the company is to install a new reverberatory furnace; the resumption of operations at the Murray lead smelter of the A. S. & R.; a payroll of $50,000 to $60,000 more at the Utah Copper mine and the Magna mill than at the first of the year; and the introduction of a number of new shippers, such as the Caliente Cobalt, the Globe, the Lincoln Mines, Buffalo and others.

✦ The old Park Galena tunnel of the New Park Mining Company, Park City district, is being reopened for a distance of 1,500 ft. to prospect the heavily mineralized Pearl fissure. Production is to be increased at the Park City Development Company on the strength of favorable mine reports.

✦ At the plant of the Park City Consolidated Mines Company a new hoist is being installed, a new road is being built, and the main shaft is being extended to the 900 level to replace a 500-ft. winze. A mineralized bed discovered 120 ft. south of the 905 drift on the East Crescent fissure that carries silver and lead greatly improves the outlook for the mine.

✦ The Zuma mine, at Eureka, Utah, resumed shipments with the reopening of the mine and starting of operations on the 600 ft. level.

✦ Work has been resumed at the Alta Helena mine, in the Alta district, on a bond and lease agreement. Leaser's in the Pacific mine, American Fork Canyon, have struck rich silver-lead ore. Shipments are being made from the Globe, in the same district, by Willard Cleghorn and S. S. Stier, leasers, who are also working the Yankee property for the A. S. & R.

✦ Directors of Silver King Coalition, at Bingham, have declared a quarterly dividend of 10c. a share, payable Oct. 1.

✦ Shipments are to be made from the New Premier Consolidated Mines, in the Spring Creek mining district. Leasers are shipping from the Buffalo Consolidated, at Ophir. Seventeen men are employed in the Lincoln mines under the direction of L. A. Sanford, manager, and a carload shipped every other day from the old Minersville property, near Milford.

✦ Damages, alleged to total $1,341,925, are claimed by 290 plaintiffs of the Utah Copper Company for injury to crops, homes, and health caused by the dust from tailings dumps. Suit was filed recently in the Third District Court, Salt Lake City. All of the plaintiffs are residents of and about Magna, where the Utah Copper operates a flotation mill. The plaintiffs seek a restraining order to force the company to take steps to prevent the blowing of the dust from tailings dumps. Damages are asked for personal discomfort and inconvenience, pollution of the air, damage to buildings, injury to livestock, crops, and shrubbery, and for alleged depreciation of market and rental and usable value of property.

✦ The connection between the triple-compartment shaft of the North Lily and the double compartment of the Big Hill, both belonging to the International Smelting Company, in the Tintic district, is being cleaned out, and work is to be resumed in Tintic Bullion ground to the west of North Lily.

✦ At Park City, the Park City Consolidated Mines Company has started unwatering the lower levels of the mine. Water will be lifted to the surface until the company completes driving a drift to connect with the Ontario No. 2 drain tunnel of Park Utah Consolidated. When this connection is made, the company will have to pump the water only to its 900 level.

✦ New mining equipment is being installed at the South Standard property, East Tintic, and a shaft is being sunk now that the geophysical work has been completed.

✦ Several months ago Charles B. Bohn, president of Bohn Aluminum & Brass Corporation, Detroit, announced small-

scale operation of a process to make aluminum from the alunite ores of Utah. He has recently stated that he will soon decide on one of several proposals for large-scale production in a plant to produce 64,000,000 lb. of aluminum per annum. Power from Boulder Dam is being considered. The products of alunite treatment would be pig aluminum and potash fertilizer.

✦ Shipments of ore and concentrates from the Walker Mine, in Plumas County, Calif., and the Mountain City Copper Mine, at Mountain City, Nev., were started on Sept. 25 as the new railroad rates to the Toole, Utah, smelter became effective.

Iron Country

✦ The Hill Annex mine has received an order for additional tonnage of iron ore to be removed before the winter freeze-up. To fill this order it will be necessary to mine at the rate of 25,000 tons per day. The eight electric locomotives are unable to handle this extra tonnage, so two steam locomotives have been added. Additional crushing is being contemplated for the washing plant to reduce more of the oversize to ¾-in. size and give it further treatment through the 25-ft. log. The mine equipment was designed for a maximum of 1,500,000 tons per year, but this year production will be close to 2,000,000 tons.

✦ The Julia mine, near Virginia, Minn., formerly known as the Bessemer mine when operated by the M. A. Hanna Company, has been leased from the Thomas Yawkey estate by the Corrigan McKinney Steel Company, and is undergoing repairs to secure its ore by underground methods. The mine has been idle for some time, and considerable work will be required to recondition the buildings and repair the shaft.

Michigan

✦ Five diamond-drill holes have been completed by the E. J. Longyear Company on the Ropes gold property, near Ishpeming, Mich., for Calumet & Hecla Consolidated Copper Company. The tract being drilled is more than a mile to the east of the shaft. The sixth hole is now in progress. Nothing has been disclosed as to the results of the work. Drifting continues east and west from the Ropes shaft. Two shifts are being employed, both on the drill and underground. Results of the drifting also are unknown, except to the management.

✦ Copper Range continues to make a favorable showing in the Globe exploratory tract, good areas of copper ore having been opened in the drifts from Champion. This property, which is being explored under option, promises to add substantially to the company's reserves.

Preliminary Work for New Shaft of Sunshine Mining Ends; Sinking Begins

Idaho's Outstanding Silver Producer Prepares to Mine on Deeper Levels to Increase Silver Production—Geological Survey of Crescent and Sunshine Areas Made From the Air—Lead and Zinc Mines Active

PRELIMINARY WORK for the sinking of the new four-compartment 3,100-ft. vertical shaft at the Sunshine mine is complete except for minor details. The haulage tunnel has been cemented and the pilot raise from the tunnel level is connected to the surface. Shaft-sinking operations will be on a three-shift basis. The installation of the large hoist is nearing completion, and headframe construction continues. The new shaft is located near the dividing line of the Sunshine Mining Company and Sunshine Consolidated. It is reported that this new shaft will facilitate mine development for both companies. Sunshine Consolidated owns about 75 claims in the center of the Bear Creek area.

✦ The Sunshine Mining Company paid a dividend of 40c. per share, totaling $600,000, to stockholders on Sept. 30. With the payment of this dividend the total for the first three quarters of the year reached $1,350,000, and the grand total paid to date is $3,774,034. The $600,000 payment is the largest in the history of the company, which began its initial dividend declarations at the rate of 2c. per share several years ago. With work on the new four-compartment shaft well under way, and a probable enlargement of the milling plant, the output of the mine will be materially increased, and the goal of 5,000,000 oz. of silver annually, set by Frank Eichelberger, manager, can probably be realized.

✦ The Jack Waite mill has resumed operations on a one-shift basis, according to an official statement by W. G. Washburn, manager of the Federal Mining & Smelting Company, under the direction of which the property is now operated. Underground work is on a one-shift basis, and the east drift on the 1,700 level is being advanced and ore sent to the mill. The company employs about 50 men.

✦ Control of the well-known Hope mine, at Clarksfork, has passed to a group of Coeur d'Alene district mining men headed by Albert M. Nash, mining engineer of Kellogg, whose previous major operation in this district was the financing and driving of the 3,000-ft. deep crosscut tunnel at the Liberal King, where an extensive orebody was recently uncovered. A new corporation known as the Hope Silver Mining Company will direct operations, Mr. Nash stated. The mine has a record of $135,000 based on net smelter returns. The new management will sink 500 ft. on the vein, cutting stations at 150-ft. intervals and blocking out ore which will be treated at the 120-ton flotation plant. The mill will later be increased to 150 tons' daily capacity.

✦ An ore disclosure of paramount importance was made at the property of the Silver Crescent Mining Company, in the Moon Creek district, where the south crosscut broke into the vein and exposed a face of silver-lead-zinc ore, the full extent of which Ross Roundy, manager, has not yet been able to determine. Much of the ore is of a clean, high-grade product which could be sorted and shipped direct to the smelter. Associated with the silver, scheelite is reported. This is the first time this mineral has been found in such quantity this side of the gold properties in the Murray district. A sample of the ore gave an assay return of 62 per cent tungsten. The finding of this tungsten attracted wide attention and brought several experts to the scene who later expressed an opinion that Manager Roundy had made one of the outstanding ore discoveries in many years.

✦ Under a contract entered into jointly by the Bunker Hill & Sullivan and the Sunshine managements a detailed study of the ledges and formations of the area lying in and between the two properties as shown from the air is now under way. A map made from photographs taken from airplanes will be constructed by leading geologists and form the basis of an important geological study. Bunker Hill owns the Crescent group, west of the Sunshine, in addition to other numerous holdings in the Big Creek area.

✦ The Sidney mine, on Pine Creek, one of the largest producers of lead-zinc ores in that section, has again become active. The mine has been closed down for several years during the low price of zinc. Ore from the Sidney is shipped to the Bunker Hill & Sullivan concentrator at Sweeney, and the zinc product from that plant is treated at the Sullivan Mining Company's electrolytic zinc plant and the lead taken to the Bunker Hill smelter. A 4½-mile tramway connects the mine with the loading bins at the mill and smelter.

Gold Mines in British Columbia Continue Their Steady Production

Big Missouri Property, in The Portland Canal District, Driving to Connect Ore Horizons at Lower Levels—New Shaft of the Pioneer Mines Now Completed at 3,500 Ft.—Morning Star Mill, in Fairview District, Operating

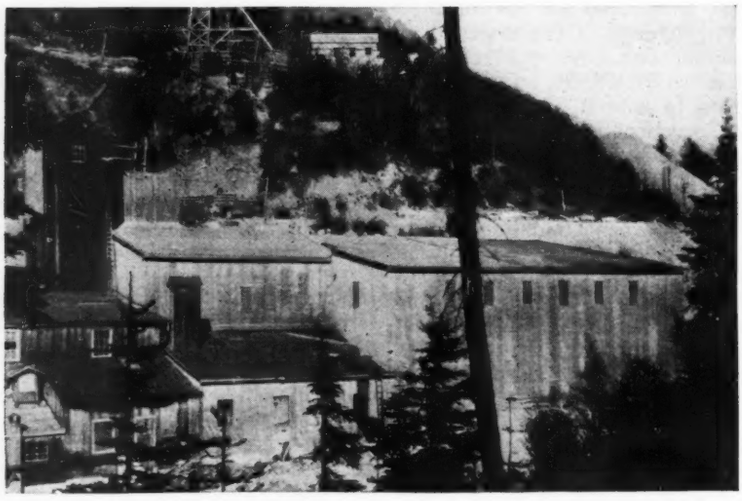
SATISFACTORY DEVELOPMENTS of the Big Missouri mine, controlled by Consolidated Mining & Smelting Company, in the Portland Canal district, have not yet reached the stage where definite plans for a concentration plant can be made. The low-level tunnel has penetrated the silicified zone in which a large orebody was cut in the Province tunnel 525 ft. above, but it is believed that the main oreshoot is still further ahead. A month will probably elapse before this is entered, and another two months before definite information is available concerning values in the lower level.

✦ The Dentonia mine, near Greenwood, produced during August concentrate of a value of $31,000 after deductions for freight and treatment charges. The mill treated 2,600 tons, recovery was 89 per cent, millhead and tailing averaged respectively 0.36 and 0.045 oz. gold, and operating costs were $4.50 per ton.

✦ In the Bridge River area, the Pioneer during August produced bullion of a value of $271,000, and earned a net operating profit of $206,000 before deductions for taxes, depletion, and depreciation. The sinking of the main shaft has been completed to the 26th level, 3,500 ft. below the surface, in preparation for a large program of development below the 14th level. The Bralorne during August treated 13,357 tons, part of which was from the Bradian workings, and produced 4,030 oz. of gold, valued at $141,050. The Ida May vein has now been opened for a distance between 800 and 900 ft., and both faces of the drift are still in ore.

✦ The mill at the Morning Star, in the Fairview district, was completed early in September and has since been treating low-grade ore from the dump at the rate of 30 tons per 8-hr. shift.

✦ The mill at the Cariboo Gold Quartz, near Barkerville, recently enlarged to 150 tons, has been in full operation since the beginning of September. Gold production during August, despite the increase in milling capacity, was lower than in previous months, the value being $38,690, compared with $41,000 in July. The decrease is attributed to the absorbtion of a considerable amount of gold by the additional solution in circuit.



Along Cadwallader Creek, in the Lillooet mining division, British Columbia is the Pioneer mine and 400-ton mill, where cyanidation is used for the recovery of gold

✦ In the Ymir district, Ymir Consolidated Gold Mines treated during August, the first full month of production, 3,227 tons, recovering bullion valued at $35,-105. Operating expenses were $15,800. The recovery was 92.7 per cent gold, 87.5 per cent silver, and 92.5 per cent lead. Broken ore in the stopes and chutes at the end of the month was 6,500 tons. Reserves at the Ymir Yankee Girl are estimated, in an interim report recently issued, to be 195,600 tons reasonably assured ore, and 56,800 tons probable ore. The grade of the former is estimated to be 0.41 oz. gold and 2.3 oz. silver. The performance of the 125-ton mill, which at first was unsatisfactory, has been improved by the cyanidation of the entire concentrate. Milling costs average $1.70 per ton on a 90-day basis, and mining costs $3.60 per ton.

✦ Milling at the Vidette, in the Kamloops district, was resumed early in September, and it is anticipated that operation of the mill at full time will be warranted by the beginning of November. The dip and strike of the fault and the relative position of the vein on the east side of the fault are now definitely known, as the fault has been intersected at three points. A short crosscut from the bottom of the 240 winze will open a considerable block of ore.

✦ The Island Mountain Mines treated in August 2,803 tons and recovered 1,571 oz. of gold, valued at $54,969. At Minks Gulch, near by, the Richfield Cariboo crosscut, at the middle of August, was in 2,453 ft. from the portal, and was believed to be 100 ft. from the main vein, which outcrops on the surface 575 ft. above.

AUSTRALIA

✦ On the Loloma property, at Tavua, Fiji, a lode has been proved in sheared andesite for 1,200 ft., and to a depth of 100 ft. there are 100,000 tons assaying 2½ oz. A tunnel 120 ft. long assays 5 oz. per ton over a width (estimated) of 12 ft. This lode is southwest from the Emperor, in which the replacement zone is up to 490 ft. wide and which contains 300,000 tons assaying 12 dwt. These two lodes are the most important so far developed on this field, which many regard as one of the most outstanding gold finds of this century.

✦ The treatment plant of Federation Tin Mines, Ltd., South Heemskirk, Tasmania, has been remodeled and extended to treat 200 tons daily. The ore is stanniferous granite in which high-grade patches occur.

✦ Wiluna appears likely to develop into Australia's largest gold mine. At present about 45,000 tons monthly of 6-dwt. ore is being milled, but both the Bulletin (owned by Wiluna Gold Mines, Ltd.) and the Moonlight (owned by Gold Fields Australian Development Company) are being equipped to each provide 10,000 tons monthly, which will be hauled by crude-oil locomotives to the main Wiluna plant. Experimental work of far-reaching importance is now

being carried out at Wiluna, including smelting auriferous antimonial flotation concentrate with lead, refining the lead and zincking to obtain the gold. The results of this departure from the present method of flotation, roasting with recovery of arsenic, and cyanidation are eagerly awaited.

✦ Zinc Corporation, Ltd., Broken Hill, treated 363,750 tons of crude ore during 1934, or 120 tons more than for 1933, and made a net profit of £131,227, an increase of £11,002. A pilot unit for deleading by all-flotation has been in operation for some time with very satisfactory results, and the construction of a new plant with a capacity of 8,000 tons weekly has been authorized.

✦ The New Red, White & Blue Company, Bendigo, is completing the installation of a cyanide leaching plant to treat 1,000 tons of battery tailing each week. The battery is to be operated at its full capacity of 800 tons weekly. Recently, the company has been treating ore assaying 3 dwt. and making a small profit.

✦ The flotation plant of Mount Morgan, Ltd., is now treating 5,000 tons weekly, and consideration is being given to the installation of another unit to give a capacity of 7,000 tons weekly. Testing of a large dump containing more than 1,000,000 tons is in progress, and from the results obtained it is believed that the material can be treated at a profit. Until mine development is sufficiently far advanced to allow 5,000 tons of ore to be mined each week, 2,000 tons of low-grade overburden will be mixed with 3,000 tons of higher-grade mine ore.

PHILIPPINE ISLANDS

✦ The 100-ton all-flotation mill of the United Paracale Mining Company, in Camarines Norte, went into operation late in May. During its first month of operation the mill heads averaged between $16 and $17 (gold at $35), and recovery was about 90 per cent. This figure is expected to be raised to 93 per cent by a readjustment of flotation reagents. Five Fagergren flotation cells and a Wilfley concentrating table are in use in the plant, which is the only all-flotation unit in the Islands. The capacity of the mill is expected to be raised to 130 tons a day by the completion of a washing plant.

✦ A new company, the Luzon Consolidated Mines, was formed recently to exploit a group of 118 chromite claims in Zambales. Dr. Antonio Alvir, consulting geologist and mining engineer for the company, has reported that prospects are good for the blocking of a sizable body of high-grade chromite ore.

New Mining and Financing Society of Mexico to Have Federal Control

Foreigners Are Prohibited From Buying Stock or Working in the Proposed 30,000,000-Peso Concern, Which Will Develop National Mineral Resources—American Smelting & Refining Company Grants Mine Wage Increases

DEFINITE ACTION by the State in the way of assistance; strikes and strike movements; wage boosts; and increased activities in several regions were the high lights of the Mexican mining industry at the close of summer.

✦ Organization of a national mining credit and financing society, the chief functions of which are to control domestic mineral markets, stimulate the industry by aiding Mexican miners, develop the establishment of smelters and metal-treatment plants, control the operations of subsidiary companies, and increase exports of metals and minerals, that was suggested some time ago by the federal government, is pronounced feasible by the Ministry of National Economy after an exhaustive study of the proposition.

Instructing and guiding Mexican technical personnel of the mining industry, establishing public markets for the purchase of ore, founding a credit system for miners and supplanting the commission promoting mining interests with an administrative board, are to be other functions of the society. Smelters and metal-treatment plants are to be established in various zones to handle ore supplied by the public. The society plans to buy much of this treated ore. It will supervise operations of companies in national mineral reserves; give technical aid to cooperative societies of Mexican miners and national mining companies; subscribe to public and private loans for the mining industry; buy, sell, or receive on deposit stocks, bonds, and other securities of any class of its associates, and aid in the execution and administration of mining works these associates perform.

The society's capital is to be not less than 30,000,000 pesos (about $9,000,000, U. S.), which is to be provided by stock: "A," 51 per cent of which will be subscribed to and permanently held by the federal government; "B," to which governments of states can subscribe to the extent of 14 per cent, and "C," which will represent 35 per cent of the capital and can be acquired by Mexican citizens. Foreigners are forbidden to buy or acquire any of this stock or to have anything to do with the operations of the society. The ministry is proceeding with plans for organization.

Part of the federal mining reserves are being exploited under concessions granted exclusively to Mexicans, the national economy ministry announces. Care is exercised that reserves be worked only by Mexicans and that they are not immoderately exploited. In granting concessions in these reserves, preference is given miners' cooperative societies in order to benefit the greatest number of persons in the mining industry. Land known as "El Porvenir," near Guadalupe de Los Reyes, Cosala municipality, Sinaloa, has been added to the federal mineral reserves.

✦ American Smelting has soothed labor uneasiness in several of its units by granting wage increases. Employees of its Charcas, San Pedro, and Barreno units, in San Luis Potosi, received increases of from 10 to 25 per cent, and the minimum daily wage of surface and underground workers of its Hidalgo del Parral and Santa Barbara (Chihuahua) units was increased by 75 centavos, affording the former class of workers 3.10 pesos and the latter 3.60 pesos (exactly $1, U. S.) per day.

✦ Workers' restlessness has also been quieted by the Cia. Minera La Masata y Anexas, S. A., operating in the Etzatlan district, Jalisco, by granting a 45 per cent wage increase, allowing free medical attention and medicines and other concessions.

✦ Efforts are being made by the federal labor department to end strikes involving the Santa Eulalia unit, Chihuahua, of American Smelting, and the San Luis Potosi working of Kildun Mining. Luis L. Rodriguez, an attorney, private secretary of President Lazaro Cardenas, has been named arbiter of a labor dispute between the Cia. Minera El Bote, operated by French interests at Santa Rosalia, Lower California Territory, and 2,500 of its workers who want new collective contracts.

✦ Improved silver conditions have prompted resumption of work in mines and metal-treatment plants of Cia. Minera de Peñoles, S. A., at Achotla, Arcelia municipality, Guerrero, that were closed since 1930, and at mines and a treatment plant of Neg. Minera y Fundidora del Lomo del Toro y Anexas, S. A., in Zimapan municipality, Hidalgo, that shut down in 1926.

✦ Preparations are being made by Cia. de Minerales del Potosi, S. A., to establish a metal-treatment plant at a cost of 216,000 pesos (about $62,000, U. S.) for two mines it operates at Guadalcazar, San Luis Potosi.

Witwatersrand Operating Costs Average Lowest in Several Years

Highest Mill Production Record Made So Far in 1935, but Yield per Ton Is Lowest in History—Gold Reported Found in Banks of Danube River—Cadmium Flue Dust From Southwest Africa Sent to Germany

London Correspondent

IT IS COMPUTED that Witwatersrand operating costs were down to 18s. 9d. per ton in July, from 19s. 1d. in June, being the lowest monthly average since May, 1926. A new milling record of 3,855,100 tons was set up in July, but the average yield, 4.681 dwt., was the lowest in the history of the district. The total value of gold produced, £6,517,816, was nevertheless a new high record. Reports so far received for August point to a slightly lower total output value.

✦ Large quantities of gold are reported to have been found in the sands of the "Blue" Danube, near Bratislavia, Czechoslovakia, and gold-washing operations are said to have begun under the direction of Professor Stoces, of the Government High School of Mining. Experts estimate that operations should yield good profits.

✦ The prospect of a further increase of mining taxation in South Africa is less threatening, as all parties seeking support in the coming election are courting the Witwatersrand vote. Appealing to the farmers of the North Transvaal, Minister of the Interior Hofmeyer declared: "You cannot go on taxing them indefinitely, for everyone suffers by restricting mining development." Those speaking for the other parties are taking much the same position. Representatives elected from the Rand are likely to control the balance of power in the next Parliament, and conditions have reached the point where pledges of a reasonable taxation policy alone will secure the Rand vote.

✦ Roan Antelope appears to have kept its production cost down during the period that it was reducing its monthly output in accordance with the international curtailment agreement, as its profit for the June quarter, after an allowance of £60,500 for debenture interest and redemption account and depreciation, was £125,500, against £68,241 the preceding quarter. This increase would seem to account in full for the £3 18s. 6d. higher average price of standard copper during the latter quarter. Net, after London expenses but excluding interest and depreciation, was £186,000, or probably over £12 per long ton with blister copper selling at prices averaging £31 17s. 11d. As the June quarter was the final one of Roan Antelope's fiscal year, its net earnings for the twelve months may now be summarized as approximately £330,647, after all deductions except taxation, with the price of standard averaging only £28 18s. 9d. per long ton.

✦ Otavi Mines & Railway, South West Africa, reports that it began early this year shipping cadmium-charged flue dust to Germany, where the cadmium is extracted, and is continuing such shipments. Its copper smelter is idle.

Yugoslavia May Become An Important Lead-Zinc Silver Producer

THE operating results of Trepca Mines Ltd., are watched closely by mining and metal interests because it is the pioneer company in the work of developing what promises to be a very important lead-zinc-silver producing district in Serbia, Yugoslavia. Trepca's profit for the June quarter, before depreciation and taxes, was £104,481. It is understood that this figure was arrived at by computing on an average price of less than £14 per ton for lead. Trepca is now developing in its extensive concession what seems likely to become another good mine. This is its Mazic property, where orebodies so far opened total a horizontal area of 600 square metres, 470 metres of which assays 7.4 per cent lead, 4.1 per cent zinc, and 4.7 oz. of silver per ton. The three related Serbian companies, Novo Brdo, Kopaonik, and Zletovo, are all developing substantial tonnages of rich ore.

✦ The Abyssinian mining and oil concession secured recently by F. W. Rickett has been given pages of publicity in Europe; but an important fact seems generally to have been overlooked. This is that though the mineral possibilities have long been recognized, the real or assumed inability of the Abyssinian Government to control the lawless activities of some of the tribes has restrained mining interests from making capital investment there. War, or war fears alone, may cement the Abyssinians and make a stable government possible. Incidentally, some of those familiar with Abyssinia are far from being convinced that Italy has an easy task before it, or is likely to win.

✦ Rhodesia Broken Hill Development Company has increased its zinc production, the August output being 1,720 long tons. Its production of vanadium concentrates was again up to 100 tons, in addition to 12½ tons of fused vanadium.

✦ The Burma Corporation reports that during the month of August, 40,741 tons of ore were mined and 34,700 tons of ore were milled in the treatment plant, producing 12,869 tons of leady concentrates. Also that 13,348 tons of lead-bearing material were smelted in the blast furnaces producing 7,100 tons of hard lead for treatment in the refinery. Refinery products were 5,880 tons of refined lead and 480,000 oz. refined silver. The zinc plant produced 7,099 tons of zinc concentrates, assaying 7.35 oz. of silver, 4.14 per cent lead, and 56.78 per cent zinc.

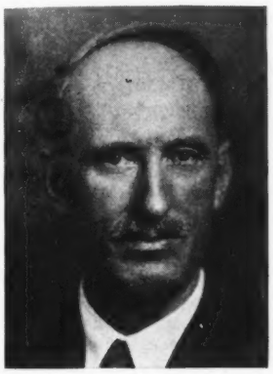
✦ Ashanti Goldfields Corporation, Ltd., reports new developments of 89.5 dwt. over 11-ft. width in its Cote d'Or; 8.8 dwt. over 48.5-ft. in its Ayeinm; and 19.5 dwt. over 10-ft. in its Justice mine. This means that excellent values are being proved in three of what have been considered its "outside" properties, and it points to an early expansion of milling capacity. Ashanti is a very rich property, with steadily growing ore reserves and a small plant. In August, for instance, it crushed 16,305 tons of ore and recovered 16,952 oz. of gold, or over an ounce per ton. Its profit was £77,536.

✦ Tarkwa Gold Areas, 51 per cent owned by American Smelting & Refining and 49 per cent by Premier Gold Mining Company, has been acquired outright by Amalgamated Blanket Areas. The purchasing company was formed this year. Its chairman, H. G. Latilla, is also chairman of Gold Coast Selection Trust. Amalgamated Blanket Areas has also acquired 92.2 per cent of the shares of Tarkwa Southern Mines. The properties acquired are the Abbontiakoon and the old Tarkwa mine. Financing has been arranged which will provide for extensive development and equipment.

✦ From the treatment of 50,273 tons of ore in August, Trepca Mines, Ltd., produced 5,172 metric tons of 78.54 per cent lead concentrates containing 24.2 ounces of silver per ton, and 7,785 tons of 49.87 per cent zinc concentrates. It is estimated that on the prevailing prices of lead, zinc, and silver, Trepca is earning at the rate of approximately 50 per cent annually on its capital.

PERSONAL ITEMS

Reconstruction Finance Corporation Supervising Engineers



WILLIAM B. GOHRING

Official appointment was recently announced of six engineers to assist applicants in making loans from the Federal Government to promote mining development. Those selected were: For Arizona-New Mexico, William B. Gohring, Phoenix; for California, B. M. Snyder, Los Angeles; for Colorado, Howard N. Lary, Denver; for Nevada. Roy A. Hardy, Reno; for Montana-Idaho, August Grunert, Helena; for Oregon, Washington, and Alaska, Alton E. Klitz, Portland. Mr. Klitz also will have an office in Juneau, where he will spend a part of his time. Details of method of obtaining Government aid were published on page 463 of the September issue of *E.&M.J.*

HOWARD N. LARY

B. M. SNYDER

AUGUST GRUNERT

ALTON E. KLITZ

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Dr. Anton Gray is on a professional trip to western Canada.

Arthur D. Storke was expected to return to London from Northern Rhodesia late in September.

Ira B. Joralemon, consulting engineer, has returned to San Francisco from a professional trip to Alaska.

A. S. Rome has been appointed to the recently created post of Chief Mining Engineer of Southern Rhodesia.

Wilbur H. Grant, consulting engineer with offices in San Francisco, has been in Colorado inspecting mine properties.

R. A. H. Flugge-de-Smidt has been elected president of the Chemical, Metallurgical, and Mining Society of South Africa.

H. H. Angst, consulting engineer of Minneapolis, has been made general mine foreman of the New Cornelia mine, at Ajo.

F. H. Elliott recently returned to the United States after completing a contract with the Patiño Mines & Enterprises, Bolivia.

Sydney H. Ball, of Rogers, Mayer & Ball, is spending the early part of October in northern Ontario on professional business.

H. D. Keiser has accepted the appointment of assistant secretary of the Alumni Association of Lehigh University, Bethlehem, Pa.

S. H. Higham has been selected as the first principal of the new school of mines at Bulawayo Technical School, Southern Rhodesia.

Norman L. Wimmler, consulting engineer, has returned to his office in San Francisco after several months of professional work in Oregon.

Sir Robert Hadfield, F. R. S., has been awarded the Albert Medal of the Royal Society of Arts, the award being conferred by the Duke of Connaught.

H. A. Geisendorfer, International Smelting & Refining Company engineer, has been placed in charge of the Walker mine, in Plumas County, Calif.

Charles Blackett has resigned the position of general manager of Boulder Perseverance, Ltd., Kalgoorlie. He will be succeeded by **E. A. Manners,** of London.

A. P. Shaw, manager of the Mexico

City Country Club, Mexico, D. F., since 1933, has joined the staff of the Rosita unit of American Smelting, in the State of Chihuahua.

Sir John Flett has retired as director of the British Geological Survey and Museum. He will be succeeded by **Dr. Bernard Smith,** assistant to the director in England.

R. T. Hopkins, formerly with the St. Louis Mining Company, of Marysville, Mont., is now mill superintendent for the Standard Silver-Lead Company at Wilborn, Mont.

Dr. C. Stansfield Hitchen, recently appointed temporary government geologist for Kenya Colony, is to conduct a geological survey of the Yala River (No. 2) area of the Colony.

Oliver Coles, formerly with International Smelting at Miami, lately in the United States Assay Office in New York, is now at Douglas with Hawley & Hawley, assayers and ore buyers.

W. P. Snyder, Jr., of Pittsburgh, president of Snyder Mining Company, inspected company mines on the Mesabi range with **E. J. Maney,** general manager, the last few days of August.

Julius Kruttschnitt, Jr., general manager and resident director of Mount Isa Mines, Ltd., and Mrs. Kruttschnitt are returning to Queensland, Australia, after an extended visit in the United States and England.

H. R. Sheppard, for the past three years with McWatters Gold Mines, at Rouyn, Quebec, as engineer, recently accepted the post of manager of the mining equipment department of Kipp-Kelly, Ltd., Winnipeg.

Walfrid Been, of Calumet, Mich., and **Carl R. Moss** recently sailed from New York to South America, where they will be employed in the exploration department of the Patiño Mines & Enterprises, Llallagua, Bolivia.

Prof. J. R. Cudworth, director of the School of Mines of the University of Alabama, has returned to the University after two months' trip through the various mining districts of Oklahoma, Colorado, New Mexico, and Arizona.

Dr. Henry Andrew Buehler, president of the A.I.M.E. and director of the Missouri Bureau of Mines, and **A. B. Parsons,** secretary of the Institute, were entertained by the Utah section of the Institute on Sept. 23 at Salt Lake City.

T. R. Makiyama, managing director of the Mitsuizumi Engineering Company, Ltd., Tokyo, Japan, has arrived in San Francisco. He will study dredging equipment and investigate dredging operations in northern and central California.

Charles T. Baroch has returned to the Bagdad Copper Corporation, at Hillside, Ariz., as general superintendent. His previous connection with the company during its operation between 1927 and 1931 was in the capacity of mill superintendent.

A. S. Walter, professor of mining and metallurgy at the New Mexico School of Mines, Socorro, N. M., has resigned as consulting engineer for Rosedale Mines—formerly the Black Bear. The company is now known as the Rosedale Gold Mines, Ltd.

G. D. Delprat, formerly general manager of Broken Hill Proprietary, Ltd., has been awarded the medal of the Australasian Institute of Mining and Metallurgy for outstanding achievement in establishing the production of iron and steel in Australia.

Ray E. Wimber, formerly mine superintendent for the Imperial Eagle Development Company, near Sumpter, Oregon, has entered the employ of C. D. Schlemmer in the capacity of superintendent of the Highland mine and mill, near Haines, Oregon.

H. D. Hunt, formerly mill superintendent for Miami Copper, recently in charge of the Empire mill for Newmont, is now metallurgical engineer for E. Long, Inc., Orillia, Canada. Mr. Hunt recently visited Miami while on a trip to the West Coast.

C. H. J. Clayton, formerly on the staff of Zinc Corporation, Ltd., at Broken Hill, N.S.W., and latterly with New Consolidated Goldfields, Ltd., South Africa, has been appointed chief mining engineer to the de Bernales group of companies in Western Australia.

Michael J. Callow, a director of the British-Geco Engineering Company, Ltd., has returned to London from an extended trip to the mining districts of the Gold Coast, Union of South Africa, Northern and Southern Rhodesia, the Belgian Congo, and British East Africa.

Professor Tokoraki and a group of other Polish scientists are reported to have discovered important manganese deposits in the Czwycsyn Mountains (Southern Carpathians, on the Polish-Roumanian border). The occurrence is estimated to contain 10,000,000 tons of ore.

E. R. Cullity, manager of the mining department of the Southwestern Engineering Company, has returned to Los Angeles from a trip to several Nevada camps, including Weepah, where his company is constructing a 250-ton amalgamation-flotation plant for the Weepah-Nevada Mining Company.

R. L. Wahl has been appointed by the Inland Steel Company to the position of general superintendent of iron-ore mines; **R. R. Satterley** has been made superintendent of Morris mine, and **F. A. Olson** superintendent of Greenwood mine. All are making their headquarters at Ishpeming, Mich.

Daniel B. Gregg has been appointed mill superintendent of Ohio Mines Corporation, which is about to install a 50-ton flotation plant to replace the cyanide plant that burned last April. Mr. Gregg was formerly in charge of the company's cyanide operations. His address is R. R. 2, Milford, Ohio.

D. C. Sharpstone, formerly chief geologist for Roan Antelope Copper Mines, is directing extensive development work on the Whitewater group of gold claims approximately 40 miles east of Juneau, Alaska. Mr. Sharpstone took a bond on the property last winter for his associates, headed by Edward C. Congdon, of Duluth, Minn.

Tasker L. Oddie, William V. DeCamp, general manager, Cardinal Gold Mining Company; **Maj. Julian Boyd,** consulting engineer and president of the Mining Association of the Southwest, and **Robert Linton,** vice-president of the Los Angeles Chamber of Commerce, were the principal speakers at the annual meeting of the Inyo-Mono Mining association held recently at Bishop, Calif.

Glenville A. Collins has completed an examination on the Amador Star and Bay State mines, on the Mother Lode near Plymouth, Calif. Sunbeam Gold Mining Company, of Arizona, has taken over the Silver Bell-Martinez mines, near Florence, Ariz., the Roadside mine, near Kingman, Ariz., and the Grass Valley Imperial, Grass Valley, Calif. Mr. Collins is consulting engineer for the Sunbeam company.

J. T. Shimmin resigned his position as manager of the San Juan Metals Corporation, Telluride, Colo., on Sept. 1 to become mill superintendent with the Buchans Mining Company, Ltd., Buchans, Newfoundland, which is jointly owned by the Anglo-Newfoundland Development Company, Ltd., and the American Smelting & Refining Company. **H. A. Guess,** of New York, is president, and **P. W. George,** manager.

F. A. Wardlaw, Jr., general superintendent for Inspiration Copper, has been transferred to Salt Lake City as manager of the Mountain City Copper Company. Mr. Wardlaw graduated from Columbia University in 1910, and was superintendent of the Utah-Delaware mine, at Bingham Canyon, and general superintendent of Mines for International Smelting before going to Arizona in 1929. His headquarters will be 810 Kearns Building, Salt Lake City.

Robert C. Meaders, now acting as chief engineer for the East Mindanao Mining Company, Placer, Surigao, P. I., has written to make correction of an item published in our July, 1935, issue in which the statement was made that he had formerly been employed as metallurgist for the Tennessee Copper Company and that he was doing geological and mining engineering consulting work in Mindanao. Though Mr. Meaders holds the degree of master of science in metallurgy from the University of Arizona and held a metallurgical fellowship in the United States Bureau of Mines, he was not, as stated, on the mill staff of Balatoc, but on the mine staff, and his position with Tennessee Copper was not as metallurgist but as chemist and microscopist. *Engineering and Mining Journal* is grateful for the opportunity to make the correction, in justice to all concerned. The information on which the original item was based was received in the course of regular field correspondence.

OBITUARY

Thomas Brown, chemist at the El Paso, Tex., Smelter Works since 1921, died on Sept. 8 in El Paso, at the age of 67.

Harald Boedtker, mining engineer, long identified with mining in the southwestern region of the United States, also died on Sept. 8 at El Paso. He was 65 years old.

Michael McGrail, assistant general superintendent of the Great Lakes Steel Corporation, of Detroit, died in that city on Sept. 9.

Albert Davey, former personnel director for Miami Copper, died in Phoenix on Aug. 30. Mr. Davey was a resident of Michigan before coming to Arizona.

M. J. Murphy, for many years mine superintendent of Mountain Copper Company, Ltd., died on Aug. 18 at Matheson, Shasta County, Calif., at the age of 60.

Francis Hawes Mitchell, who had been in charge of the departments of mining and ore dressing at the Camborne (England) School of Mines, died recently at the age of 63.

Charles Hugh Spencer, a pioneer of the Rand, formerly general manager of Treasury Gold Mine and Consolidated Main Reef, died recently in South Africa. He was 66 years old.

Louis C. Reis, former president and general manager of the Minnesota Steel Company, died on Sept. 8 in Pasadena, Calif., at the age of 55. He was one of the outstanding executives of the Lake Superior region.

Henry Lee, one of British Columbia's outstanding mining engineers, died on Sept. 29. He had followed his profession in the Province for more than 30 years and was a member of the Association of Professional Engineers.

Edward C. Simmons, Duluth traffic manager for the Oliver Iron Mining Company, operating in Michigan, Minnesota, and Wisconsin, died on Aug. 28 of heart disease, at the age of 53. He had been with the company for 25 years.

Charles W. Gardiner, identified with the California dredging industry since 1900 and for many years operating superintendent for Yuba Consolidated Goldfields, died recently in San Francisco. Mr. Gardiner was over 70 years of age.

Edward Remington Nichols, retired treasurer of the Nichols Copper Company, died on Oct. 1 at his home in Orange, N. J., at the age of 72. Mr. Nichols was the son of the founder of the Nichols Copper Company, the late George A. Nichols.

Sylvanus Albert Reed, a Columbia School of Mines alumnus mining engineer, who more than 50 years ago engaged in mining work in Colorado, and who since 1921 achieved distinction as the inventor of the Reed duralumin airplane propeller, died on Oct. 1 in New York City, at the age of 81.

Oscar Jensen, superintendent of the Alamo mine of the Cia. Minera Real del Monte y Pachuca, S. A., died on Sept. 8 in Pachuca, State of Hidalgo. He was 48 years old. Mr. Jensen began his mining career in Mexico in 1905 as mine captain for the Camelia mine, in Sonora. He had worked in the Pachuca sector since 1920.

W. R. Rogers, chief of the publications branch of the Ontario Department of Mines, died on Sept. 8 in Toronto. Mr. Rogers had done geological surveying in northern and northeastern Ontario prior to his connection with the Ontario Department of Mines. He was a member of the Canadian Institute of Mining and Metallurgy.

Willem Sebastian Smits, J. P., manager of the claims and estates department of New Consolidated Goldfields, Ltd., died at Parktown, South Africa, on Aug. 21. Mr. Smits had been associated with Consolidated Goldfields since 1897 and at the time of his death he was also a member of the board of the Simmer & Jack and Robinson Deep mines.

Frank H. Hitchcock, former Postmaster General and a Rocky Mountain member of the A.I.M.E., died recently at the age of 65. Mr. Hitchcock had been interested in government and politics since 1903. He was chairman of the Republican convention of 1908, and after the election was made a member of the Cabinet. He was a colonel in the Officers Reserve Corps of the Army Air Corps, a member of the American Economic Association, and a fellow of the American Statistical Association.

James Henry Ronaldson, for many years a prominent British consulting engineer, died on Aug. 5 at the age of 77. In 1896 Mr. Ronaldson went to New South Wales, and he practiced his profession in Australia, Tasmania, and New Zealand for five years, later going to Rhodesia, Mozambique, Madagascar, Cape Colony, and Little Namaqualand. Since 1912, interrupted only by the War, he had maintained a consulting office in London. He was a member of the Institution of Mining and Metallurgy, the Institution of Mining Engineers, and a fellow of the Geological Society of London.

Marion Mercer died at Guadalajara, Mexico, on Sept. 22, 1935, of pneumonia, cutting short at the age of 36 a most promising career in the mining field. Mr. Mercer was born at Paxton, Ill. He studied at Butler University and later, in 1930, received the degree of E.M. from the Colorado School of Mines. After varied mining experiences in Colorado, he joined the staff of the Museum of Science and Industry, Chicago, as Assistant Curator of Geology and Mineral Industries, which position he held until his death. During 1933 and 1934 Mr. Mercer, while on leave of absence from the Museum, designed, built, and operated the Diamond Exhibit at the Century of Progress Exposition. At the time of his death, he was again on leave of absence and had just completed the examination of gold and silver properties in Jalisco. Mr. Mercer was a member of Tau Beta Pi and Theta Tau. He was also a Lieutenant in the 24th Engineers (Officers' Reserve).

Thomas Haight Leggett, long a distinguished mining engineer and consultant in this country and abroad, died at Plainfield, N. J., on Oct. 1 at the age of 76. Mr. Leggett was graduated from Columbia School of Mines in 1879 and one of his first professional engagements was in the Batopilas Mine at Chihuahua, Mexico, a property owned by the late Alexander R. (Boss) Shephard, the first and last governor of the District of Columbia. From 1884-1887 Mr. Leggett was mining engineer for the New York & Honduras Rosario Mining Company and also consulting engineer for the Darien Gold Mining Company. In 1888 he assumed management of the Standard Consolidated Mine at Bodice, Calif., of which he later became president. From 1895 to 1903 he was in Johannesburg, S. A., as consulting engineer for S. Neumann & Company. On his return from South Africa Mr. Leggett established himself in London, where he maintained a consulting engineering business until 1907, when he removed to New York and opened offices. In 1912 he became consulting mining engineer for the American Smelting & Refining Company. He resigned from active business three years ago.

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A LETTER

Metallurgy at Clear Creek, Colo.

The Editor:

I have made further inquiries regarding the xanthates used in flotation work in Clear Creek and Gilpin Counties, Colo., and find no foundation for my statement that methyl xanthate is used. Therefore I wish to correct a misstatement in my article which appears on pages 410-11 of *Engineering and Mining Journal* for August, 1935, Vol. 136, No. 8. In the last sentence where I have written "methyl xanthate," sodium ethyl xanthate and pentasol xanthate should be substituted. A. W. NEWBERRY.

Denver, Colo.

NEW BOOKS

An Intimate Record of Canada's Mining History

MINE-FINDERS. *The History and Romance of Canadian Mineral Discoveries. By B. F. Townsley. Printed by the Saturday Night Press, Toronto. Distributed by Macdonald Galleries, 26 Grenville St., Toronto, Canada. Pp. 246. Price $3.*

Though the history of mining in Canada begins with Lief the Lucky, who reached Labrador in 1000 A.D., 500 years elapsed before Cabot, in 1497; Cartier, in 1534, 1536, and 1541; and Frobisher, in 1576, reported to the European souvereigns who had sponsored their adventures the tidings of that land "rotting with gold." Not gold and silver, however, but coal, copper, iron, furs, and Indians attracted the attention of the early adventurers.

Jacques Cartier, who reached the site of what is now Montreal on Oct. 2, 1536, was, according to the record, the first to traffic in Canada's precious metals. Forty years elapsed before Martin Frobisher took 200 tons of "black earth," which he thought was gold ore, to Queen Elizabeth. On test in England it was found to be iron pyrites—fool's gold—and for a time further quest languished. Samuel de Champlain, with one Monsieur Prevert and Master Simon, a mining engineer, in 1640 discovered in Canada mines of copper, iron, silver, and galena.

Nova Scotia was the real cradle of Canadian mining. Coal was shipped from Grand Lake to Boston by water as early as the middle of the seventeenth century.

Iron smelting in Quebec started in 1660. In 1775, when Benedict Arnold's American troops seized Three Rivers, he compelled a local smelter to supply cannon balls with which to bombard Quebec!

Not until 346 years after Cabot's expedition and reports did the Government of Canada give serious consideration to the mineral resources. The year 1843 marks the real beginning of the country's mining history. In 1842 William Logan arrived in Kingston to conduct a geological survey of the Province of Canada. He became the first Director of the Geological Survey of Canada, a post which he occupied until 1869. Knighted in 1856 for his investigations and reports, Logan was not alone the father of the Canadian mining industry, but to him goes the honor, also, for discovering the deposits of anthracite in Pennsylvania.

Asbestos was discovered in Quebec in 1877 by Ficteau in Thetford and Coleraine townships. Production started in 1885.

In Ontario, Sieur Chevalier de Troyes in 1686 realized the mineral potentialities of the Cobalt area, and he recorded many investigations, but in all the years until 1850, little developed from his discoveries at Temiskaming. In the latter year E. D. Wright, Ottawa timber man, kicked up some soft lead-bearing ore with the calk of his boots. He took samples to Ottawa, where they lay on his desk for twenty years. Then an assay showed them to contain silver and lead. The vision of C. C. Farr, factor of Hudson's Bay Company at Temiskaming, was largely responsible for the construction of the Temiskaming & Northern Ontario Railway in 1901. The digging of a bed for the railway along Long Lake (Cobalt Lake) led to the exploitation of Cobalt's silver bonanza.

The discovery of Flin Flon, in Manitoba, dates from 1914, when Tom Creighton, following moose, came upon a protruding mineralized dike of chalcopyrite and schist. (The name "Flin Flon" is a contraction of "Flinotin Flonneroy," leading character in "The Sunless City," a novel of a still earlier date.)

British Columbia was visited by Juan de Fuca in 1592, who recorded that "In divers places it is rich in gold, silver, pearl, and other things." Other explorers followed, their labors mainly fallow. The first commercial gold discovery in the Province dates from 1851.

Between 1896 and 1907 almost $123,000,000 was taken from the placer deposits of the Yukon and its tributaries. The rôles played by Skookum Jim, Tagish Charley, George Cormack and his wife, Rovert Henderson, George Bentley, "Soapy" Smith, Henry Tok Smith, and the Royal Canadian Mounted Police are told with zest and journalistic accuracy of detail.

Mr. Townsley, a Canadian himself, and for some years editor of *The Financial Post* and *Saturday Night*, brings to the telling of his story an intimate knowledge of the history of mining in Canada. With many engineers and industrialists of this generation he has had an opportunity to cultivate personal acquaintance. One lays down "Mine-Finders" conscious of a few hours profitably spent. The volume will find a welcome place in the libraries of all concerned with mining industries of the continent, not alone for the record made so conveniently available, but for the reason, also, that to read it is good fun.

For the Prospector

HANDBOOK FOR PROSPECTORS. THIRD EDITION. *By M. W. von Bernewitz. McGraw-Hill Book Company, 330 West 42d St., New York. Pp. 372. Price $3.*

Since the appearance of the second edition of this book, Mr. von Bernewitz has visited Australia and New Zealand (the latter being his birthplace), and, moreover, a great expansion in gold-mining activities has taken place throughout the world. These events find some reflection in the latest revision, in new observations and additions to the text. The principal change has been made, however, in the section devoted to detection and use of minerals. In place of one chapter dealing with metallic and non-metallic minerals, the two classes have been dealt with separately and at greater total length. Other rearrangements of the text are noted. New sections dealing with maps and foreign mining laws have been added. The discussion of geophysical prospecting that appeared in the second edition has been omitted, as being rather too deep for the average prospector's needs.

A New "Mineral Industry"

THE MINERAL INDUSTRY, 1934. *Edited by G. A. Roush. McGraw-Hill Book Company, New York. Pp. 739. Price $12.*

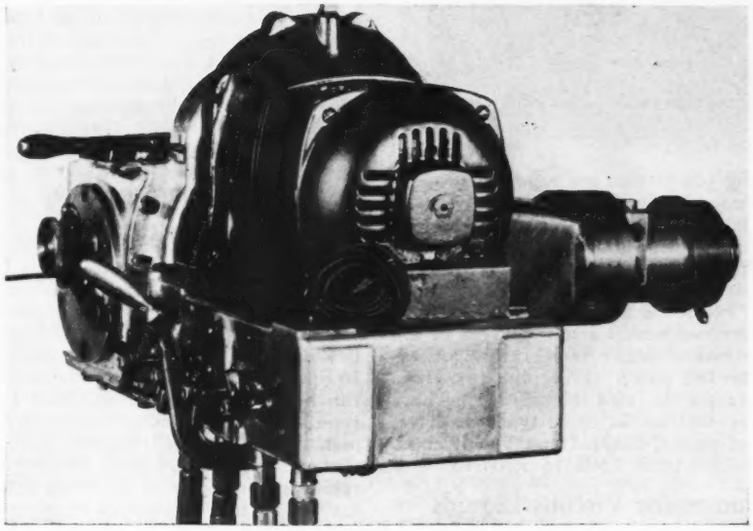
Supplementing 42 preceding volumes, this is the 43d consecutive annual publication of statistics and information on the mineral industries of the world. As with the two preceding volumes, publication of Vol. 43 was made possible by the cooperation of the American Institute of Mining and Metallurgical Engineers in its distribution. Contributors of the various chapters are authorities in their respective subjects. They draw on world-wide sources of information. In addition to chapters on the metals, non-metals, and non-metallic minerals, the book contains related information on the value of foreign currencies, state geological surveys, trade associations in the mineral industries, and professional organizations. A new feature is a table of United States tariff rates on minerals and metals covered in the volume. The objective of "Mineral Industry" is to present a concise summary of economic and technical conditions in the most important branches of the industry, and from as many as possible of the producing countries. Long continuity of the publication makes it particularly valuable for purposes of comparison. The introduction to Vol. 43 comments on the status of the mineral industries in the United States as compared with those in foreign fields.

Publications Received

General Statistics Covering Costs and Production of Michigan Iron Mines, 1934. Compiled by F. G. Pardee, mine appraiser, and W. Osgood, geologist. Department of Conservation, Geological Survey Division, Lansing, Mich. Pp. 8.

Construction and Equipment of the Ross Shaft, Homestake Mining Co. By G. N. Bjorge, A. J. M. Ross, J. D. Johnson, S. J. Staple and J. F. Wiggert. T. P. 621, A.I.M.E., New York. Pp. 43.

EQUIPMENT NEWS



New Metal Spray Tool

PROGRESS in the art of spraying metal is claimed for the Gillord spray now available through the Gillord Sales Corporation, Graybar Building, New York City. This tool will deposit 12 to 15 lb. of alloy steel per hour, and a correspondingly greater quantity of other metals, depending on their melting points; namely, 25 to 35 lb. of copper per hour. Greater density and freedom from oxidation are claimed for the deposited metal. The process is useful for building up worn surfaces of machine parts or surfacing new parts with expensive alloys of desired properties. It is also found applicable in such work as making dies for stamping purposes.

The tool is mounted on a lathe post or other fixture, or it can be movably suspended, depending on the character of the work to be done. A fractional-horsepower motor drives the adjustable metal feed; otherwise there are no moving parts. Metering gas jets for oxygen, acetylene, air, and inert gas are set at the factory and require no further adjustment. Metal from the wire feed is melted in a small chamber in the head of the tool, where it is said to be protected from oxidation by an envelope of inert gas to the point at which the deposit is made.

Diesel Starting Unit

A new, single-stage air compressor for starting gas and diesel engines is reported by the Cooper-Bessemer Corporation at Mount Vernon, Ohio. This new unit is said to be capable of filling a tank of 6-cu.ft. capacity up to 200-lb. pressure in five minutes, or up to 250-lb. in nine and a half minutes. The compressor is known as the GX 3A and is said to run equally well on either gas or gasoline. Ford parts are largely used —pistons, piston rings, connecting rods, connecting-rod bearings, engine valves, and many other smaller parts. Both power and compressor cylinders are cast in one piece and are water-jacketed. The power-cylinder head, which is a separate casting, is of the automotive type, water cooled, and has one spark plug. A one-gallon gasoline tank is mounted over the compressor and connected to the carburetor. Where gas is the fuel, it is possible to start the engine on gas, but the recommended procedure is to start with gasoline, and then switch to gas.

Automatic Time Switches

Wide adaptability, simplicity, reliability, and low-cost installation and maintenance are features said to characterize the new types T-17 and T-27 automatic time switches now available from the General Electric Company, Schenectady, N. Y. These switches are reported suitable for all general domestic and industrial purposes.

The Type T-17 time switch will control almost any electric circuit on a schedule related to the time of day. It will perform any practical number of operations per day and can be set to skip one or more days if desired. The standard switches are designed for a-c circuits, 115 and 230 volts. Current rating is 40 amperes per contact. The triple-pole switch will handle 120 amperes, split load, thus saving the cost of additional contactors. Either a plain dial (for fixed time setting) or an astronomic dial (for sun schedules) or certain combinations of both can be furnished.

The Type T-27 time switch is similar to the Type T-17 except that it is not equipped with a weatherproof case or with an omitting device for selected days. It is for indoor service only.

In both types, the drive is direct from a Telechron motor through a compact spur-gear train. The switching mechanism is said to be simple and operates quick-make and quick break silver contacts. Installation apparently is not difficult and is accomplished without removing the mechanism from the case.

Stylish Safety Goggles

The American Optical Company, Southbridge, Mass., announces a new safety goggle which is said to offer features expected to make goggle enforcement programs easier. For the customary nosepiece, the new goggle

substitutes pearl full rocking nose pads, which distribute the weight for the goggle on the sides rather than on the top of the nose. Earpieces are of flexible cable, completely insulated so that no metal touches the skin at any point. The earpieces are set high on the rims, removing obstruction to full side vision and adding to the goggle's style. This goggle is said to be fitted

with the new six-curve Super-Armorplate lenses, capable of withstanding blows approximately twice as heavy as those which fracture standard lenses. The domed surface of the lens is declared to be exceptionally effective in deflecting glancing blows. Lenses are shaped to fit closely to the eye without interfering with eyebrows or lashes.

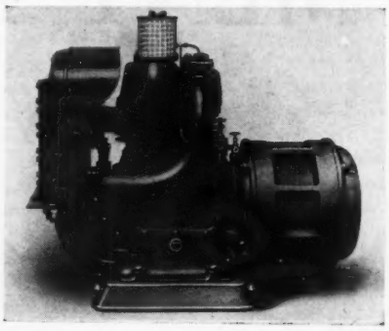
Drilling on Balloon Tires

It is ordinarily known that pneumatic tires serve their best purpose on motor trucks and passenger cars as they are being driven over the highways. It is said their advantages of motive performance have found a way into the mining

field, not only making portable drilling rigs easier to transport but also promoting a higher performance in rapid drilling. The Cleveland Rock Drill Company, of Cleveland, Ohio, reports the use of the DR 6 drill rig with a pneumatic tire set-up which is said to keep the drill steel rotating freely and easily in actual drilling operation, thereby promoting more rapid drilling. This rig is said to have given satisfactory performance in contract and quarry work.

Air-Cooled Compressor

The Chicago Pneumatic Tool Company, of Cleveland, Ohio, announces a new line of air-cooled compressors, among which is the PM-2, with the built-in motor shown in the accompanying illustration. Air cooling is employed in the compressor because tests indicate it to be more economical than water cooling and it avoids the danger of freezing in cold weather. The vertical-in-line arrangement of the air cylinders permits using a separate crankpin for each connecting rod, which is said to facilitate crankpin bearing adjustments greatly, locates all cylinders in the direct path of the blast of cool air from the fan, and simplifies the piping. Forced-feed lubrication throughout is said to assure positive and controlled supply of oil for the cylinders and bearings, avoiding oil pumping. The full



floating piston pins are reported to eliminate completely the possibility of piston-ring seizure and scoring of cylinders. The air-cooled finned intercooler, with sectionalized core, and served by a V-belt drive from the compressor crankshaft, cools the air between stages to a temperature within a few degrees of the low-pressure intake temperature, effecting the full power saving the two-stage compressor is said to afford. These compressors are in three types of drive, built-in motor, coupled and V-belt class, and weigh from 1,925 to 5,700 lb.

Pumps for Viscous Liquids

Heavy-duty rotary pumps produced by Worthington Pump & Machinery Corporation, Harrison, N. J., are said to pump practically all kinds of clean liquids as well as thin, thick, viscous, hot, cold, corrosive, or other liquids, including those that solidify when cool, such as asphaltum, resin, lard and soap. Complete lines of standard and steam-jacketed pumps of this type are made to handle pressures up to 300 lb. per square inch, temperatures up to 650 deg. F., with capacities of from 10 to 2,500 g.p.m. For viscous and solidifying liquids the pumps are steam-jacketed. For high temperatures the stuffing boxes are water-jacketed. Internal sleeve and internal roller bearings are used for non-corrosive liquids; external ball bearings for corrosive liquids. These pumps are said to be efficient over a wide pressure range.

The continuous-tooth double-helical gear rotors, eliminating all end thrust, are mounted on stiff shafts with large, high-capacity bearings. The pumps are said to give straightway continuous non-churning and non-foaming discharge. Other features mentioned are the absence of valves, gaskets, trappings of liquid, pulsations, and that all parts are easily accessible. The single extra-deep stuffing box on the internal-bearing type of pump is subject to suction pressure only. These pumps are said to operate quietly and to handle readily considerable vapor, air, or gas suspended in the liquid, and they are applicable to practically any drive arrangement.

Oil-Resisting Belt

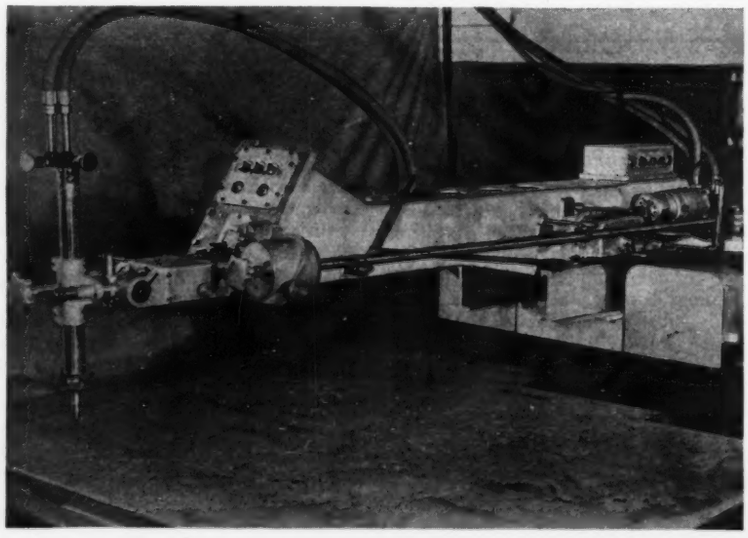
Announcement is made by the L. H. Gilmer Company, Tacony, Philadelphia, Pa., that it has placed on the market a type of belt made both in V type and flat Kable Kord type, a belt said to be 100 per cent oil resistant. Mechanically, the belt has the same qualities as the regular Gilmer rubber-fabric type of belt. Materials used, however, are such that either type of belt, V or flat, is oil-resisting and said to be impervious to the destructive inroads of oil in contact with rubber, which has been a troublesome factor in operation of this type of belting in industrial work.

Clinker Cooler

Developments in new equipment offered by the Traylor Engineering & Manufacturing Company, Allentown, Pa., include the Traylor-Cheesman Patented Rotary Clinker Cooler and the Traylor-Cheesman Patented Burner, which are said to yield high efficiency in cooling and effect great savings of kiln fuel.

The Traylor-Cheesman Cooler is a

The Linde Air Products Company, of New York City, announces a new Oxweld shape-cutting machine, Type CM-12, which features dual control and incorporates modern mechanism of new design for efficient operation and precision



compact unit of the three-pass type, said to assure cooling of clinker to within at least 100 deg. of atmosphere, with full recovery of the heat contained in the clinker. Air introduced into the cooler travels counterflow with the clinker and is in intimate contact with the heat-transfer elements. Two basic elements of heat transfer are utilized—namely, high velocities of gases and ample heat radiating surfaces, in order to make the cooler very compact.

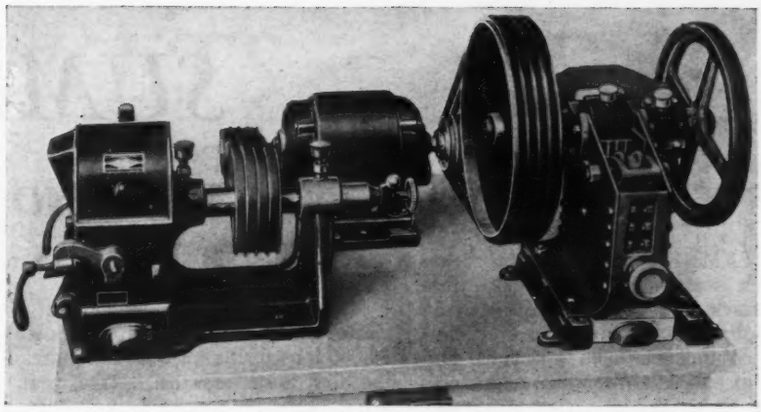
The cooler is completely inclosed within the shell, and is accessible. Due to the distribution of the loads, a minimum of power is required for driving.

In a Traylor-Cheesman cooler and burner installation only one fan is required and little attention is said to be needed for controlling the air. When a Traylor-Cheesman burner is operated in connection with a Traylor-Cheesman cooler, all of the air required for cooling is used in the kiln for combustion, and no waste of either heat units or of power is said to take place.

Cantilever Grizzly

The Allis-Chalmers Manufacturing Company, of Milwaukee, Wis., announces an improved bar screen of the cantilever type, or with bars fixed only at the upper end of the grizzly. The absence of bar tie rods at the lower end eliminates the clogging experienced with the ordinary type of bar screen.

Impact of the material on the grizzly is said to cause the overhung free ends of the bars to vibrate horizontally, keeping the material from wedging. With this higher efficiency it is reported that higher tonnages can be handled more effectively. The advantages of this improved bar screen are said to be low first cost, low maintenance cost, ease of operation, ease of repairs, and the fact that no moving parts require power. These cantilever grizzlies are available with openings from 1 in. to 3 in. between the bars, according to individual requirements, and are tapered in section and are said to be made of the highest quality manganese steel, to resist wear.



Crusher and Pulverizer With V-Belt Drive

DEVELOPMENT of a new unit consisting of the Braun Chipmunk Crusher and UA Pulverizer with a close coupled V-belt drive is announced by Braun Corporation, of Los Angeles, California. The crusher and pulverizer are mounted together with an electric motor on a substantial wooden base. The entire unit is said to occupy a space of only 3x4 ft. and it can be set in a corner of the laboratory out of the way. The purpose of the new development for the equipment is to provide the laboratory worker with these two essential machines in a form highly compact and efficient. The use of the V-belt drive is said to minimize belt-drive power losses and belt slip, and also to eliminate dust-catching, power-wasting and oftentimes dangerous overhead shafting. Each set of belts can be tightened independently of the other. The new unit is available with either the Type VC Chipmunk crusher, having a capacity of 400 lb. per hour, or the WC Type, having a capacity of 1,500 lb.

BULLETINS

Turbine Pumps. Worthington Pump & Machinery Corp., Harrison, N. J. Types Q and QA turbine pumps for 30 to 225 U. S. g.p.m. Bulletin W-450-B-19. Pp. 4.

Steam Booster Compressors. Worthington Pump & Machinery Corp., Harrison, N. J. Bulletin L-611-B3A. Pp. 4.

Portable Compressor. Worthington Pump & Machinery Corp., Harrison, N. J., Bulletin W-850-B-51. Model 315 gasoline-driven compressor, 315 cu.ft. per minute actual air. Pp. 4.

Conductor Data for Rural Electric Lines. General Cable Corp., 420 Lexington Ave., New York City. Bulletin Re-1, giving physical and electric characteristics of conductors for rural-line construction. Pp. 24.

Protective Devices for Head, Eyes, Nose, and Throat. Willson Products, Inc., Reading, Pa. General catalog of goggles, respirators, fume and smoke masks, welding and abrasive blasting helmets and hand shields.

Mine Haulage. C. S. Card Iron Works Co., Denver, Colo. Booklet of mine cars, sheaves, rope haulage equipment, and car wheels. Pp. 20.

Diesel Locomotives. Ruth Company, Continental Oil Building, Denver, Colo. Descriptive catalog of diesel locomotives for mine and surface haulage. Pp. 12.

Arc Welding. Lincoln Electric Co., Cleveland, Ohio. Descriptive booklet of service electrode used in repairing alloys and steels subject to abrasion, impact, and corrosion. Pp. 14.

Gate Valves. Lukenheimer Co., Cincinnati, Ohio. Circular No. 504, illustrating inside screw, outside screw type, bronze body, or all-iron gate valves. Pp. 7.

Temperature Chart of Alloy Steels for Industrial Use. Hadfields, Ltd., East Hecla Works, Sheffield, England. A graphic chart, No. T-6084, shows a wide range use of mainly ferrous-type alloys, for various industrial purposes where requirements demand a temperature range from absolute zero to 1,300 deg. C.

Overlay Metal. Colmonoy, Incorporated, P. O. Box 977, Los Nietos, Calif. Bulletin 40. Metallic crystals are said to be free of tungsten and carbon which fuse with other metals, promoting wear- and corrosion-resistant properties. Pp. 15.

Speed Control Handbook. Reeves Pulley Co., Columbus, Ohio. Information on methods of variable-speed regulation for industrial machines. Pp. 112.

Synthetic Rubber-Like Material. B. F. Goodrich Co., Akron, Ohio. Uses of Koroseal and its various properties. Pp. 12.

V-Belt Construction. Manhattan Rubber Manufacturing Division, Passaic, N. J. Bulletin 6840. Diagrams describing construction details of Condor V-Belts. Pp. 4.

Crushers. C. G. Buchanan Co., 90 West St., New York City. Capacities, power consumption, speed, and construction of large rock crushers. Pp. 18.

Copper Water Tubing. Chase Brass & Copper Co., Waterbury, Conn. Illustrated bulletin of uses, installation, and fittings of copper tubing. Pp. 48.

Bronze Types and Forms. Chase Brass & Copper Co., Waterbury, Conn. Catalog of bronze strips, sheets, plates, wire, pipe, and castings and weight tables. Pp. 31.

Brass Copper Bronze Products. Catalog of warehouse stocks and miscellaneous products of Chase Brass & Copper Co., Waterbury, Conn. Pp. 100.

Time Switches. General Electric Co., Schenectady, N. Y. Automatic-control time switches for general-purpose applications. Bulletin GEA-1427 D. Pp. 7.

Pebble Mills and Mixers. Paul O. Abbe, Inc., Little Falls, N. J. Folder. Pp. 7.

Welding Rod. American Manganese Steel Co, Chicago Heights, Ill. Bulletin 10. Nickel Manganese Steel welding rods. Pp. 5.

Rotary Pumps. Worthington Pump & Machinery Corp., Harrison, N. J. Bulletin W-475-B8, three types of double helical rotary pumps. Pp. 11.

SUMMARY OF

MONTHLY COMMENT . . . DAILY AND AVERAGE MONTHLY

SEPTEMBER got off to a rather slow start, but, on evidence that business activity has moved to an even higher level than in the preceding month, confidence soon returned and buying of major non-ferrous metals was resumed on a broad scale. The war clouds over Europe undoubtedly had some influence on the general situation. Prices for copper, lead, and zinc advanced. Tin averaged a little lower here than in the month previous, but the price remained firm in London, where the shortage of spot material continued. Silver in the open market held at 65.375c. throughout the month, largely on support from the Treasury. Fairly good purchases of antimony, coupled with moderate offerings from China, caused the price to advance 1½c.

Our weighted index number of non-ferrous metal prices—copper, lead, zinc, silver, tin, aluminum, and nickel—was higher, the figure for September being 75.73, against 74.00 for August and 73.53 for July.

Attention centered in copper. Domestic sales for the month amounted to 84,000 tons, bringing total purchases for the first nine months of the year to about 437,700 tons. Actual domestic consumption of new copper, according to trade authorities, amounted to about 365,000 tons in the Jan.-Sept. period. Stocks of refined metal on Sept. 1 were reduced in this country to 248,000 tons, of which quantity barely 150,000 tons might be considered as metal readily available to consumers, the remainder being "not for sale" at this time. Part of the metal reserved for future sale cost more than 9c., and part is owned by consumers. Domestic production of copper is being increased and should add about 7,000 tons to monthly output before the end of the year. The domestic price of copper advanced to 9c., Valley, Sept. 18, a return to the level that prevailed when NRA was in force. The foreign price advanced on encouraging developments here and assurances that world production is being held in check.

Lead was in good demand and a moderate reduction in stocks served to bring about an advance of 15 points, establishing the market at 4.50c., New York, and 4.35c., St. Louis. Current quotations for lead are 1c. higher than the low for the year. United States stocks of refined lead on Sept. 1 totaled 227,583 tons. Lead in London moved above £17 per ton on good buying for account of consumers and speculators.

Zinc, Prime Western, advanced to 4.75c., St. Louis, a new high for the movement. Reports on consumption of zinc were favorable.

The International Tin Committee, on Sept. 11, decided to continue tin-production quotas at 65 per cent of so-called capacity.

United States Market

1935 Sept.	Electrolytic Copper Domestic (a)	Electrolytic Copper Export (b)	Straits Tin New York	Lead New York	Lead St. Louis	Zinc St. Louis
2	Holiday	7.900	Holiday			
3	8.275	7.900	48.875	4.35	4.20	4.60
4	8.275	7.875	48.550	4.35	4.20	4.60
5	8.275	7.900	48.700	4.35	4.20	4.60
6	8.275	7.900	48.650	4.35	4.20	4.60
7	8.275	7.925	48.650	4.35	4.20	4.60
9	8.275	7.925	48.500	4.35	4.20	4.60
10	8.275	7.925	48.250	4.35	4.20	4.60
11	8.275	7.950	48.625	4.35	4.20	4.60
12	8.275	8.000	49.000	4.35	4.20	4.60
13	8.275	8.075	49.125	4.35	4.20	4.60
14	8.275	8.125	49.200	4.35	4.20	4.60
16	8.275	8.200	49.625	4.35	4.20	4.60
17	8.275	8.275	49.500	4.35	4.20	4.60
18	8.775	8.275	49.400	4.35	4.20	4.75
19	8.775	8.275	49.350	4.50	4.35	4.75
20	8.775	8.325	49.100	4.50	4.35	4.75
21	8.775	8.325	49.100	4.50	4.35	4.75
23	8.775	8.325	48.750	4.50	4.35	4.75
24	8.775	8.350	48.875	4.50	4.35	4.75
25	8.775	8.375	49.400	4.50	4.35	4.75
26	8.775	8.375	49.675	4.50	4.35	4.75
27	8.775	8.375	49.875	4.50	4.35	4.75
28	8.775	8.375	50.000	4.50	4.35	4.75
30	8.775	8.400	50.250	4.50	4.35	4.75
Av. for month	8.504	8.146	49.126	4.413	4.263	4.669
Averages for Week						
4	8.275	7.913	48.985	4.35	4.20	4.60
11	8.275	7.921	48.563	4.35	4.20	4.60
18	8.358	8.158	49.308	4.35	4.20	4.625
25	8.775	8.329	49.096	4.50	4.35	4.750
Calendar Week Averages						
7	8.275	7.900	48.685	4.350	4.200	4.60
14	8.275	8.000	48.783	4.350	4.200	4.60
21	8.608	8.279	49.346	4.425	4.275	4.70
28	8.775	8.363	49.429	4.500	4.350	4.75

Silver, Gold, and Sterling Exchange New York and London

1935 Sept.	Sterling Exchange "Checks"	Sterling Exchange "90-day Demand"	Silver (c) New York	Silver London	Gold London	Gold (d) United States
2	Holiday			29.0000	140s 3 d	Holiday
3	4.95750	4.94750	65.3750	29.2500	140s 3 d	35.00
4	4.95000	4.94000	65.3750	29.1250	140s 4 d	35.00
5	4.94250	4.93250	65.3750	29.0625	140s 7½d	35.00
6	4.93250	4.92250	65.3750	29.1875	140s 10 d	35.00
7	4.92625	4.91625	65.3750	29.2500	141s 1 d	35.00
9	4.92875	4.91750	65.3750	29.1875	141s 2 d	35.00
10	4.93625	4.92500	65.3750	29.1875	140s 7½d	35.00
11	4.93625	4.92500	65.3750	29.3125	140s 9½d	35.00
12	4.93625	4.92500	65.3750	29.3750	140s 11 d	35.00
13	4.93750	4.92625	65.3750	29.5625	140s 10½d	35.00
14	4.94750	4.93500	65.3750	29.3750	140s 7½d	35.00
16	4.94375	4.93125	65.3750	29.3750	140s 5 d	35.00
17	4.93750	4.92625	65.3750	29.1875	140s 9½d	35.00
18	4.92750	4.91500	65.3750	29.1875	140s 11 d	35.00
19	4.92250	4.91125	65.3750	29.1875	141s	35.00
20	4.91750	4.90625	65.3750	29.3125	141s 4 d	35.00
21	4.91250	4.89875	65.3750	29.2500	141s 5 d	35.00
23	4.91000	4.89625	65.3750	29.3125	141s 6 d	35.00
24	4.92000	4.90750	65.3750	29.3125	141s 6 d	35.00
25	4.93000	4.91625	65.3750	29.1875	141s 1 d	35.00
26	4.91375	4.90000	65.3750	29.2500	141s 3½d	35.00
27	4.91250	4.89750	65.3750	29.3125	141s 6½d	35.00
28	4.91125	4.89500	65.3750	29.3125	141s 6 d	35.00
30	4.91000	4.89500	65.3750	29.3125	141s 6½d	35.00
Av. for month	4.92917	.....	65.375	29.255	.....	35.00
Averages for Week						
4	4.96125	.....	65.375	.....	.....	.....
11	4.93375	.....	65.375	.....	.....	.....
18	4.93833	.....	65.375	.....	.....	.....
25	4.91875	.....	65.375	.....	.....	.....

Calendar week averages: New York Silver Sept. 7th, 65.375; 14th, 65.375; 21st, 65.375; 28th, 65.375.

The above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis, add 0.225c. per pound, the average differential for freight and interest charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Most sales in the foreign market are made on the basis of c.i.f. usual ports of destination—Hamburg, Havre, and Liverpool. The c.i.f. basis commands a premium of 0.300c. per pound above our refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High-Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than the *E. & M. J.* average for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly mined domestic. Under Executive order issued April 24, 1935, the U. S. Government's price on newly mined domestic silver was established at 77.57.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125 per ounce.

THE MARKETS

PRICES OF METALS . . . MISCELLANEOUS QUOTATIONS

London Market

Sept.	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic Bid	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
2	33.0000	33.3750	36.7500	220.2500	210.1250	15.5625	15.6250	14.9375	15.2500
3	33.1250	33.5000	36.7500	220.7500	210.2500	15.6875	15.7500	15.0625	15.3750
4	32.8125	33.2500	36.7500	219.5000	209.0000	15.5625	15.6250	14.9375	15.2500
5	33.1875	33.6250	36.7500	220.0000	208.2500	15.5625	15.6250	15.0000	15.3125
6	33.3750	33.8125	37.0000	220.7500	209.0000	15.6250	15.7500	15.1250	15.4375
9	33.5625	34.0000	37.2500	219.5000	209.2500	15.6875	15.7500	15.1875	15.5000
10	33.4375	33.8125	37.0000	218.2500	208.0000	15.5625	15.6875	15.1250	15.4375
11	33.6875	34.1250	37.2500	219.0000	209.0000	15.6875	15.7500	15.1250	15.3125
12	33.6875	34.0625	37.2500	221.7500	210.2500	15.9375	16.0000	15.2500	15.4375
13	34.1250	34.5625	37.5000	222.0000	212.5000	16.0625	16.1250	15.2500	15.3750
16	34.3750	34.8750	38.0000	225.2500	214.5000	16.1250	16.1875	15.2500	15.4375
17	34.6250	35.0625	38.2500	226.0000	214.0000	16.3750	16.4375	15.2500	15.5000
18	34.5000	34.9375	38.2500	226.8750	214.0000	16.5000	16.5625	15.5000	15.7500
19	34.4375	34.8750	38.5000	227.1250	214.5000	16.5000	16.5625	15.5625	15.7500
20	34.5625	35.0000	38.7500	226.7500	215.1250	16.5625	16.5625	15.3750	15.6250
23	34.5000	34.8750	38.7500	225.7500	214.2500	16.6250	16.6875	15.5000	15.6875
24	34.4375	34.8125	39.2500	224.7500	213.5000	16.8750	16.9375	15.5000	15.6250
25	34.8125	35.1250	39.2500	227.0000	214.5000	17.1875	17.1875	15.9375	16.0000
26	34.8125	35.1875	39.2500	229.7500	216.0000	17.3125	17.3125	16.1875	16.2500
27	34.7500	35.1250	39.2500	229.0000	216.7500	17.3125	17.3125	16.3750	16.3750
30	34.9375	35.2500	39.2500	232.5000	218.7500	17.1875	17.1875	16.2500	16.2500
v. for month...	34.036	.....	37.952	223.929	.....	16.262	16.315	15.414	15.616

Current Prices—Miscellaneous Metals, Ores, and Non-Metallic Minerals

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated.

(October 1, 1935)

Miscellaneous Metals

Aluminum, ingot, 99 per cent plus, lb.	19@21c.
Antimony, domestic or Chinese (duty paid), lb.	14c.
Bismuth, ton lots, lb.	90c.
Cadmium, lb.	85c.
Chromium, 97 per cent grade, lb.	88c.
Nickel, electrolytic cathodes, lb.	35c.
Magnesium, 99.8 per cent, carloads, lb.	30c.
Palladium, troy oz.	$24.00
Platinum, (official quotation) troy oz.	$36.00
Quicksilver, flask of 76 lb., 100 flasks or more	$69.50
Radium, mg. radium content	$50.00
Selenium, 99.5 per cent, lb.	$2.00
Silicon, minimum 97 per cent. spot, lb.	16.50c.
Tellurium, lb.	$2.00
Thallium, 100 lb. or more, lb.	$6.50
Titanium, 96 to 98 per cent, lb.	$6.00
Zirconium, commercially pure, lb.	$7.00

Metallic Ores

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 45@47 per cent, c.i.f., long ton	$16.00@$16.50
Iron Ore, Lake Superior, long ton:	
Old Range bessemer	$4.80
Mesabi bessemer	$4.65
Old Range, non-bessemer	$4.65
Mesabi, non-bessemer	$4.50
Lead (Galena) 80 per cent. Joplin, Mo., ton	$47.00
Manganese Ore, c.i.f. Atlantic ports, long ton unit:	
52@55 per cent.	26c.
49@51 per cent.	25c.
44@47 per cent.	24c.
Molybdenum Ore, per lb. of contained MoS_2	42c.
Tungsten Ore, per unit of WO_3:	
Chinese duty paid	$16.00
Domestic Scheelite	$15.75
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton.	$31.00

Metallic Compounds

Arsenious Oxide (arsenic) lb.	3½c
Cobalt Oxide, 70@71 per cent, lb.	$1.39@$1.49
Copper Sulphate, 100 lb.	$3.85
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb.	$1.24
Sodium Sulphate, bulk, ton.	$13.00@$15.00

Alloys

Beryllium-Copper, Master alloy, 3.5 per cent Be, per lb. of contained Be	$30.00
Ferrochrome, 65@70 per cent chromium, 4@6 per cent carbon, lb.	10c.
Ferromanganese, 78@82 per cent, gross ton	$85.00
Ferromolybdenum, 50@60 per cent Mo, lb. of Mo contained.	95c.
Ferrosilicon, 50 per cent, gross ton	$77.50
Ferrotungsten, 75@80 per cent, lb. of W contained	$1.35@$1.45

Non-Metallic Minerals

Asbestos, f.o.b. mines, ton:	
Canadian (Quebec)	
Crude No. 1	$500@.....
Crude No. 2	$200@$225
Spinning fibers	$90@$135
Paper stock	$32.50@$37.50
Shorts	$11@$14.50
Vermont	
Shingle stock	$47@.....
Paper stock	$35@.....
Cement stock	$23@.....
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 95 per cent $BaSO_4$, less than 1 per cent iron	$5.50
Bauxite, long ton:	
Domestic, chemical, 55@58 per cent	$6@ $7.50
Domestic, abrasive, 78@84 per cent	$12.50@$15.00
Dalmatian, 50@55 per cent	(a) $4.50@ $6.00
French, 56@59 per cent	(a) $5.50@ $6.50
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, bulk	$6.00@ $8.00
Delaware, No. 1	$14.00@.....
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85-5 per cent, all rail movement, ton	$14.50
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00@.....
Dead-burned, f.o.b. Washington	$22.00@.....
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½x2 in.	15@30c.
2x2 in.	30@50c.
2x3 in.	50@65c.
3x4 in.	90c@ $1.25
4x6 in.	$1.50@ $2.50
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.50
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12@ 12½c.
Silica, water-floated, in bags, 325 mesh, ton	$16.00@$40.00
Sulphur, Texas mines, long ton	$18.00@.....
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$8.50@ $9.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$16.00@.....
200 mesh, cream colored	$26.00@.....

(a) Nominal.

Iron and Steel

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$19.00
Basic	$18.00
No. 2 Foundry	$18.50
Steel, base prices, Pittsburgh:	
Billets gross ton	$27.00
Structural shapes, 100 lb.	$1.80
Bars, 100 lb.	$1.80

MONTHLY AND YEARLY AVERAGE PRICES

Silver and Sterling Exchange

	Silver New York		Silver London Spot		Sterling Exchange "Checks"	
	1934	1935	1934	1935	1934	1935
January. ...	44.188	54.418	19.382	24.584	504.644	489.207
February. ..	45.233	54.602	20.073	24.818	503.085	487.278
March	45.875	59.048	20.278	27.380	509.259	477.635
April.....	45.180	67.788	19.740	30.986	515.210	483.596
May.....	44.226	74.356	19.276	33.865	510.510	488.587
June.....	45.173	71.940	19.981	32.346	504.721	493.245
July.....	46.310	68.216	20.512	30.500	503.990	495.558
August.....	48.986	66.366	21.377	29.476	506.398	496.815
September...	49.484	65.375	21.888	29.255	499.344	492.917
October.....	52.375	.....	23.581	.....	494.019	.....
November...	54.255	.....	24.257	.....	498.832	.....
December...	54.390	.....	24.404	.....	494.520	.....
Year.	47.973	.....	21.229	.....	503.711	.....

New York quotations for silver not eligible for sale to U. S. Government, cents per ounce troy, 999 fine. London, pence per ounce sterling silver 925 fine. Sterling exchange in cents.

Copper

	F.O.B. Refinery Electrolytic Domestic		F.O.B. Refinery Electrolytic Export	London Spot Standard		London Spot (a) Electrolytic	
	1934	1935	1935	1934	1935	1934	1935
January.....	7.890	8.775	6.583	32.560	28.077	35.614	31.261
February....	7.777	8.775	6.341	33.072	27.175	35.969	30.244
March.....	7.775	8.775	6.526	32.497	28.518	35.512	31.607
April.....	8.173	8.775	7.328	33.006	31.231	36.038	34.763
May.....	8.275	8.775	7.794	32.662	33.344	35.756	36.733
June.....	8.594	8.634	7.307	32.149	30.799	35.339	34.039
July.....	8.775	7.775	7.350	29.707	31.024	32.778	34.261
August.....	8.775	7.979	7.738	28.358	32.646	31.483	35.976
September...	8.775	8.504	8.146	27.541	34.036	30.556	37.952
October.....	8.775	.....	.....	26.753	.....	29.478	.....
November...	8.775	.....	.....	27.233	.....	30.222	.....
December...	8.775	.....	.....	27.836	.....	31.086	.....
Year.....	8.428	.....	.....	30.281	.....	33.319	.....

New York quotations, cents per pound. London, pounds sterling per long ton. (a) Bid quotation.

Lead

	New York		St. Louis		London			
	1934	1935	1934	1935	1934 Spot	1934 3 Mos.	1935 Spot	1935 3 Mos.
January....	4.000	3.692	3.900	3.542	11.304	11.517	10.321	10.514
February...	4.000	3.528	3.900	3.378	11.634	11.913	10.216	10.413
March.....	4.000	3.579	3.900	3.429	11.545	11.842	11.012	11.188
April.....	4.179	3.692	4.042	3.542	11.500	11.794	12.231	12.459
May.....	4.140	3.962	3.990	3.812	11.051	11.341	13.861	13.940
June.....	3.975	4.020	3.825	3.870	11.054	11.253	13.776	13.806
July.....	3.772	4.123	3.623	3.973	10.813	11.045	14.451	14.511
August.....	3.747	4.254	3.597	4.104	10.821	11.028	15.774	15.792
September..	3.685	4.413	3.535	4.263	10.388	10.613	16.262	16.315
October....	3.654	.....	3.504	.....	10.359	10.554	.....	.....
November..	3.567	.....	3.417	.....	10.432	10.597	.....	.....
December..	3.604	.....	3.454	.....	10.316	10.500	.....	.....
Year.....	3.860	.....	3.724	.....	10.935	11.166	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	Straits New York		Standard, Spot London	
	1934	1935	1934	1935
January.....	51.891	50.916	226.631	231.193
February.....	51.668	50.063	226.731	227.381
March.....	53.838	46.962	233.863	215.726
April.....	55.622	50.154	239.181	223.513
May.....	53.541	51.138	234.239	227.602
June.....	51.271	51.108	226.875	227 586
July.....	51.930	52.297	230.381	232.397
August.....	51.953	50.463	228.114	222.935
September.....	51.503	49.126	229.888	223.929
October.....	50.951	.....	230.587	.....
November.....	51.227	.....	228.602	.....
December.....	50.902	.....	228.178	.....
Year.....	52.191	.....	230.273	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1934	1935	1934 Spot	1934 3 Mos.	1935 Spot	1935 3 Mos.
January.....	4.271	3.730	14.688	14.943	11.994	12.207
February....	4.384	3.714	14.844	15.125	11.819	12.000
March.....	4.368	3.894	14.735	15.033	12.095	12.250
April.....	4.370	4.030	14.916	15.200	12.891	13.128
May.....	4.346	4.220	14.722	14.966	14.534	14.685
June.....	4.240	4.299	14.241	14.467	13.734	13.898
July.....	4.317	4.325	13.466	13.693	14.065	14.185
August.....	4.281	4.535	13.682	13.756	14.714	14.938
September...	4.049	4.669	12.644	12.847	15.414	15.616
October.....	3.832	.....	12.217	12.353	.....	.....
November...	3.732	.....	12.000	12.281	.....	.....
December...	3.711	.....	11.730	12.016	.....	.....
Year.....	4.158	.....	13.657	13.890	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Cadmium and Aluminum

	Cadmium		Aluminum	
	1934	1935	(a) 1934	(b) 1935
January.....	55.000	55.000	23.300	20.000
February.....	55.000	55.000	23.300	20.000
March.....	55.000	58.462	23.300	20.000
April.....	55.000	65.000	23.300	20.000
May.....	55.000	65.000	23.300	20.000
June.....	55.000	65.000	23.300	20.000
July.....	55.000	65.000	23.300	20.000
August.....	55.000	70.000	23.300	20.000
September.....	55.000	75.625	23.300	20.000
October.....	55.000	.....	23.300	.....
November.....	55.000	.....	23.300	.....
December.....	55.000	.....	23.300	.....
Year.....	55.000	.....	23.300	.....

Aluminum in cents per pound, 99 per cent grade. (a) Based on Aluminum Company's quotation. (b) Open market price.
Cadmium, cents per pound.

Antimony, Quicksilver, and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1934	1935	1934	1935	1934	1935
January.....	7.198	14.111	67.538	72.760	38.000	34.000
February.....	7.172	14.250	72.011	72.500	38.000	34.000
March.....	7.545	14.250	75.472	72.500	38.000	32.846
April.....	7.918	14.029	75.930	72.500	38.000	32.000
May.....	8.465	12.712	75.577	72.135	36.538	32.000
June.....	7.900	12.500	75.000	71.460	36.000	32.000
July.....	8.024	12.500	75.000	70.538	36.000	32.000
August.....	8.514	12.500	75.000	69.000	36.000	31.333
September.....	8.745	13.177	74.563	69.208	36.000	36.000
October.....	9.361	.....	74.000	.....	35.038	.....
November.....	12.239	.....	73.283	.....	35.000	.....
December.....	13.730	.....	73.000	.....	35.000	.....
Year.....	8.901	.....	73.865	.....	36.465	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

Pig Iron

	Bessemer		Basic		No. 2 Foundry	
	1934	1935	1934	1935	1934	1935
January....	18.00	19.00	17.00	18.00	17.50	18.50
February...	18.00	19.00	17.00	18.00	17.50	18.50
March.....	18.00	19.00	17.00	18.00	17.50	18.50
April.....	18.48	19.00	17.48	18.00	17.98	18.50
May.....	19.00	19.00	18.00	18.00	18.50	18.50
June.....	19.00	19.00	18.00	18.00	18.50	18.50
July.....	19.00	19.00	18.00	18.00	19.50	18.50
August.....	19.00	19.00	18.00	18.00	18.50	18.50
September..	19.00	19.00	18.00	18.00	18.50	18.50
October....	19.00	.....	18.00	.....	18.50	.....
November..	19.00	.....	18.00	.....	18.50	.....
December	19.00	.....	18.00	.....	18.50	.....
Year.....	18.707	.....	17.707	.....	18.207	.....

Iron in dollars per long ton. F.o.b. Mahoning and Shenango Valley furnaces.

H. C. PARMELEE
Editorial Director

Engineering and Mining Journal

A. W. FISHER
Manager

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Vice-President

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formerly General Manager, Airmap Corporation of America

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"In my professional travels," says Arthur Notman, consulting mining engineer and geologist, "I have flown something over 75,000 miles in the last five years, 25,000 miles since the first of the year. I have flown in the United States, Canada, Central America, Colombia, British Isles, France, Italy, Greece, Egypt, the Sudan, Uganda, Kenya, Tanganyika, Northern Rhodesia, Southern Rhodesia, and the Union of South Africa. I have found it a great time saver; also much less tiring than the same mileage by train or other means of transportation. I have had no personal experience in the use of airplanes for transporting freight, but have seen enough of it in Canada to be convinced that it has speeded up development in remote gold areas tremendously."

●

Geophysical prospecting is feasible from the air, thinks Dr. C. A. Heiland, of Golden, Colo. Gravity mapping from planes offers interesting possibilities; has already been accomplished from submarines. Likewise, electrical measurements have been made from above, in an experimental search for minerals. More progress might have been scored to date had the trend in such surveying been less toward accuracy, more toward speed. Professor Heiland will present his views in an early issue.

●

Shipping "By Air" over Canadian Airways, one is requested to dispense with *heavy* wooden cases. Instructions run: "Save weight — save freight. Loads must be checked with care. Correct markings are important." But aërial transport loses its airy atmosphere when a two-ton tumbler shaft is carried.

Air Travelers passing through M'beya, in Tanganyika, are at times afforded scenes, in the local hostelry, that remind them of a Bret Harte story. A miner toils in from across the mountains, with hard-won gold packed in rough containers such as cigarette tins. One of these he pushes across the counter in the bar.

"Let me know when that's used up," he says.

The barman weighs the tin in an expert hand.

"Ought to last you about a week," he says tersely.

The miner draws up a chair, settles himself in a corner, and makes himself at home.

●

Hugh M. Wolflin wrote the first complete story of mining aviation, a story that has never yet been published, save in abstract form. It is the manuscript entitled "Use of Airplanes in Mining and Petroleum Operations," which Mr. Wolflin prepared for the United States Bureau of Mines, while supervising engineer of the Intermountain Experiment Station at Salt Lake City, Utah. An original manuscript that is rare indeed!

●

Mineral leases in Indian lands in the Tri-State zinc-lead district require government supervision and Charles F. Williams, in charge of the work for the United States Geological Survey, uses an airplane in making his necessary rounds. His records show that light two- or three-place cabin planes powered with 90- to 125-hp. engines have been operated at a cost comparable with that of a medium-priced automobile. Average operating cost has proved 5.4 cents per mile. Average miles per gallon of gasoline is 12.9.

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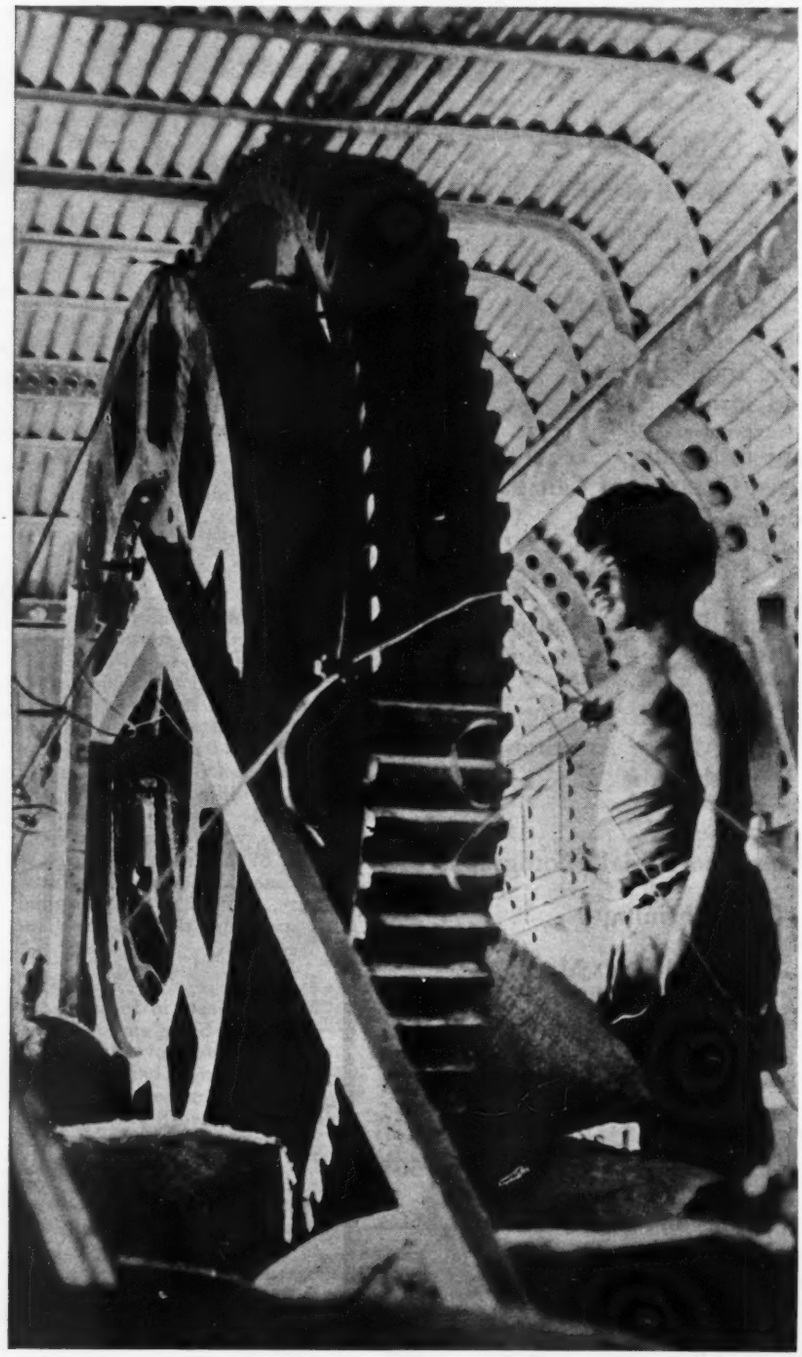

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